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JPRS Report

Science & Technology

China

Science & Technology
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JPRS-CST-94-008 CONTENTS 24 May 1994

Science & Technology

Science & Technology Policy

Advanced Materials and Superconductivity

Aerospace

Biotechnology

Computers

Defense Technology

Factory Automation and Robotics

Lasers, Sensors, Optics

Microelectronics

Telecommunications

Energy

National Developments

Hydropower

Thermal Power

Coal

Oil and Gas

Nuclear Power

Alternative Energy

Science & Technology Policy

Jining New and Hi-Tech Industrial Development Zone's Priorities

40101006A Beijing CHINA DAILY in English 11 Apr 94 p 1

[Text] Ninety-one projects with a total investment of 1.2 billion yuan ($149.5 million) have been allowed to enter Jining New and Hi-Tech Industrial Development Zone and 15 have a total foreign funds of $57 million.

Thirty-one projects have been built and five have started production in rented workshops outside the zone.

The zone has signed cooperation agreements with more than 20 science research institutes and colleges such as the State Council's Electronics Promotion Office, Beijing University, Qinghua University, the State Commission for Science, Technology & Industry for National Defence and East China College of Science and Engineering.

Since the zone was established in July, 1991, more than 150 overseas business people have visited it and more than 20 contracts signed.

Huanong Group, a large power company, has invested in real estate in the development zone.

The following industries are the zone's priorities:

A. Microelectronics and electronic information technology and products.

B. Technology for the unification of optics, electronics and machinery and their products.

C. Technology for bioengineering and its products.

D. Material science and new material technology and products.

E. Energy science, new energy and power-saving technology and products.

F. Ecology and environmental protection technology and products.

G. Medical science and biological medicine technology.

H. Other new techniques and technologies based on traditional industries.

All these industries will benefit from all State and provincial preferential policies as well as those particular to the zone.

The cost of residential land with ready infrastructure is 210 yuan ($24.14) per square metre, for industrial land it's 180 yuan ($20.69) and for commercial and trade land it's 240 yuan ($27.58).

The zone's administration council is responsible for examining,evaluating, approving, administrating commerce and industry, tax, planning and construction.

Investors can do all the procedures to establish enterprises without leaving the zone.

Scientists Achieved Significant Results Over Past Year

40101006B Beijing CHINA DAILY [SCIENCE/MEDICINE] in English 13 Apr 94 p 5

[Article by Shao Ning: "Scientists Make Lots of Significant Discoveries"]

[Text] Chinese scientists working with the Chinese Academy of Sciences have made new advances over the past year in various basic research fields.

And the latest achievements have been acclaimed in world scientific and technological circles, according to the academy's annual report.

An abstract theory explaining the structure of minimal surface in Riemann's multi-dimensional space has been developed by Wang Guangyan, with the assistance of his PhD student, at the Institute of Mathematics.

The theory is the fruit of a synthetical study which brings together various branches of mathematics. Consequently, many famous mathematicians believe that the methods and ideas it introduces will have a long-standing influence on mathematical research.

In the field of mathematical statistics, Fang Kaitai at the Institute of Applied Mathematics and Wang Yuan at the Institute of Mathematics won international recognition last year for their new experimental design method based on the Theory of Numbers concept.

Their method has been widely and successfully used in China in agricultural, medical and chemical engineering research during the past decade and is now being applied to research projects throughout the world.

In the field of mechanics, Wang Ziqiang at the Institute of Mechanics has made considerable headway in the area of elastoplastic crack mechanics.

Since he won support from the China Natural Science Foundation for his crack analysis project, Wang has been constructing a mathematical model to describe the stress field of cracks. The aim is to explain the effect of external force upon given materials and provide a theoretical basis for the establishment of crack rules. Wang's work has been highly praised by authorities in this field.

In the field of physics, Ouyang Zhongcan, a research fellow at the Institute of Theoretical Physics, used the liquid crystal method to come up with a biological membrane model. The method has enabled him to solve many equations and deduce a model for the changes that take place in a biological membrane.

Biologists have proved his deductions with their experiments, and Ouyang has offered scientific explanations for many previously unexplained experimental phenomena.

Ouyang's work has brought condensed matter physics into biology. And he won the 1993 Outstanding Achievement Award from the Chinese Physics Committee.

Meanwhile, scientists at the Institute of High Energy Physics (IHEP) observed a laser oscillation signal in infrared and then achieved a saturated oscillation signal at the Beijing Free Electron Laser (BFEL) facility. This achievement confirms China's leading position in this field.

Scientists at the State Molecular Reaction Dynamics Lab in the Institute of Chemistry discovered a new tubular-structured hydrocarbon by using their time of flight serial mass spectrometer.

After the experiment they drew the conclusion that aromatic synthetic materials are often made up of these tubular-structured hydrocarbon—and that the specific differences between such materials is determined in their atomic component in diameters and the number of bonds with the hydrogen atoms.

The research has been highly praised by Professor Smalley—the discoverer of C60, and professors Dudley Robert Herschbach and Yuan Tseh Lee—both winners of the Nobel Chemistry Prize in 1986.

And advances have been made in research into how life on earth started. Scientists at the Institute of Organic Chemistry of Shanghai have accomplished the total and serial synthesis of molecule Nodrm-1, which plays the role of information transmitter between azotobacteria and bean plants.

Scientists have also dug deep into the structure of the Nodrm-1 molecule. This work will help research into the mechanism of nitrogen fixation, an important area of study in life chemistry.

In the field of biology, significant progress has been made in the area of trio-dimensional structures and the function of large molecules at the Institute of Biophysics.

Scientists have identified the crystal structure of one of the largest proteins on earth at a higher resolution than any other that was previously reported in the world. The protein, called phycoerythrin, has a molecular mass 45 times greater than that of insulin. And the research will assist photosynthesis of the protein.

Another research achievement was the discovery of well-preserved ape-man skull fossils in Tangshan. The discovery will supply much information on mankind's origin, evolution and early migration.

In other fields, the Institute of Botany has established a brand new information system on the pteriophyte family in China.

Meanwhile, Shi Liming at the Institute of Zoology of Kunming found that pandas lack variety in their protein heredity, which may serve as one of the major reasons for pandas' near extinction.

Also astronomers at the Beijing Astronomical Observatory observed and researched the supernova SN1993J by using the 2.16-metre telescope in the Xinglong Observatory.

They found and then explained both the tremendous blue shift in its spectrum and its asymmetry in explosion. Other basic research breakthroughs include the supersensitivity mini cyclotron acceleratormass spectrometer, the synthesis of the new isotope thorium (Th237), the self-calibrated modulation convergence theory and work on how land atmosphere interacts with and influences the climate.

In industrial research, the Chinese Academy of Sciences in cooperation with local businesses has developed new manufacturing and automation techniques for boiler makers, chemical companies, textile producers, processing plants and machinery factories.

And a 863 state high-tech parallel computer has been developed at the Institute of Calculation. The computer uses many new techniques like data oriented processing. The calculation speed of the computer can run as high as 120 million instructions per second.

The Gold Office of Academia Sinica organized several gold prospecting research projects last year.

Headway has been also made in other applied research areas—synthetic fuel oils, fine bone pottery, high efficiency emulsion, and rain forecasting.

Scientists also developed the model for an agricultural disaster warning system by using remote sensing techniques and geographical information systems. Agronomists bred nine new varieties of rice, cotton, and other crops.

Researchers with the science academy received hundreds of awards in 1993.

Basic research and synthetic studies in frontier and multi-disciplinary areas will continue to receive support from the State.

And the institutes within the academy will establish sound links with universities and industries over the next few years.

State To Enforce Copyright Protection

40101006C Beijing CHINA DAILY [OPINION] in English 29 Apr 94 p 4

[Text] The government is working to effectively implement its "Copyright Law," said a senior legislator on Tuesday.

And rules are being made to crack down on exporters who abuse foreign intellectual property rights, according to Cai Cheng, vice-chairman of the Law Committee of the National People's Congress.

Customs will aim to prevent pirated goods from being shipped out of the country, he said.

And on the domestic front law enforcement bodies will investigate "major and important" cases in cooperation with the departments of science, technology, culture, public security, industry and commerce.

Intellectual property rights courts are already operational in Beijing, Shanghai and Shenzhen, the booming special economic zone adjacent to Hong Kong.

The Central government will improve its supervision of law enforcement by local authorities, Cai said.

But while the government will do its best the non-governmental sector is being encouraged to help, Cai said.

Lawyers and auditors and professional science, technology and culture associations must all do their bit.

"When organized, they can provide services, including legal consultancy and investigations into complaints," he said.

According to official statistics, an average of 13,000 cases of trademark abuse and counterfeit goods are reported every year, including 500 that directly affect foreign companies.

Cai attributed this to the fact that intellectual property protection is still new in China. "But the country is sincere and serious in its effort to improve,"he said.

The country is now a member of the World Intellectual Property Rights Organization and has signed the Paris Convention on Industrial Property Rights Protection, the Madrid Convention on International Registration of Trademarks and the Berne Convention for the Protection of Literary and Artistic Works. (XINHUA)

Technologies Critical To China's Economic Development Published

94P60241A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 2 Mar 94 p 1

[Summary] In order to raise China's overall national strength, the State Planning Commission, recently the State Science and Technology Commission and the State Economic and Trade Commission jointly published the "Critical Technologies for China's Economic Development in the 199Os". The purpose of this plan is to promote industries' productivity by rebuilding China's lagging production industries. Technologies considered vital to China's economic prosperity and development for the 199Os and the next century are listed in priority order based on the technologies needed for China's economic development, with a special focus being put on industrial technology. The list includes 35 projects in seven areas:

1) Agriculture: Two projects on crop breeding technology and technology to manage low- and medium-crop production areas in order to achieve high-quality, high-yield production.

2) Energy resources and environment: Five projects on low-tempetature nuclear reactor district heating technology, tertiary oil exploitation technology, and clean coal utilization technology.

3) Transportation: Three projects on high-speed railway transportation, high-grade highways and inland water transport technologies.

4) Raw and Processed Materials and Natural Resources: Seven projects on sheet-bar continuous roll milling and continuous casting technology, oxygen-coal iron-smelting technology, heavy oil processing technology, manufacturing technology for important fine chemical engineering products, engineering plastics and plastic alloy technology.

5) Information and Telecommunications: Nine projects on integrated circuits, computers, softwares, power electronics, automation, and fiber optics.

6) Manufacturing Technology: Eight projects on numerical control technology, laser technology, and technology for manufacturing complete set of large-scale thermal power plants.

7) Biotechnology: Six projects on animal and plant genetic engineering, hybridoma-production technology, industrial microbial technology, and protein engineering.

Six Engineering Research Centers Established in Shaanxi

94P60214B Xian SHAANXI RIBAO in Chinese 3 Mar 94 p 1

[Summary] Six of China's projected 40 State Engineering Research Centers will locate in Shaanxi with a total investment of 350 million yuan. Three Research Centers established last year were the "Liquid State Machine and Compression Engine Engineering Research Center" of the Xian Jiaotong University, the Ministry of Energy's "Clean Coal Combustion for the Power Plants Engineering Research Center" of Xian Thermal Power Research Institute, and the "Telecommunication Exchange and Software Support System Engineering Research Center" of the Tenth Research Institute of Ministry of Posts and Telecommunications. The engineering research centers aim at conducting engineering research and systematic integration of research institutes' important S&T achievements with great market value, and then transform these results into large-scale industrialized production. In order to accelerate the conversion of these results, speed up development of

China's industrial production technology, and promote international competition, the engineering research centers are also exloring effective models and new operation guidelines to be adopted by Chinese government in the future.

State Natural Sciences Foundation Adopts New Form of Funding

94P60214C Beijing RENMIN RIBAO in Chinese 2 Feb 94 p 3

[Summary] The State Natural Sciences Foundation (NSFC) has initiated in recent years the joint funding of projects. The joint funding approach has been undertaken to facilitate the prioritization of allocating important national S&T resources, promote closer ties between basic and applied research, enhance national economic construction, and to accelerate development and conversion of basic research results. The NSFC and 20 other related departments including the Ministry of Construction and the Ministry of Geology and Mineral Resources, provinces, municipalities and industries have cooperated in funding 262 projects, with 9.777 million yuan coming from NSFC and 7.445 million yuan from the other participants. This cooperation effort has resulted in a marked improvement in S&T research, an increase in the number of qualified S&T personnel, and the promotion of high-tech industry growth. According to statistics, 19 of the 'Seventh 5-Year Plan' and the 'Eighth 5-Year Plan' key projects are funded jointly, with a total amount of 51.43 million yuan coming from the participants; and the 'Eighth 5-Year Plan' key S&T projects were also supported by 5.7 million yuan of joint funding. The joint funding effort also worked successfully from collaboration with the State key laboratories and the State open laboratories on S&T research projects. In 1992, 62 of the 186 NSFC-supported projects, which received a total funding of more than 95 million yuan, had close ties with the State key laboratories, and 37 of them were linked to the open laboratories. Meanwhile, the NSFC is also encouraging the research institutes and industries, and also colleges, universities and industries to apply for joint fundings for their research projects for the purpose of bringing industries, institutes, and universities closer.

The NSFC has also been very successful in promoting other multi-channel fundings through international cooperation. For example, on 28 October 1993, the NSFC signed a 'Ford-China Research and Development Foundation Agreement' with U.S. Ford Motor Company to initiate the international cooperation. Furthermore, the NSFC is exploring other cooperative channels with the local governments to promote S&T progress and to foster training of qualified S&T personnel. Presently the NSFC is establishing the 'Zhongmi S&T Revitalization Foundation' with the Mi County of Henan Province.

Zhang Cunhao [1728 1317 3185], Chairman of NSFC, pointed out that in order to promote ties between S&T and national economy to a new level, the NSFC is planning a new joint research project to cover all industries, universities, and research institutes under this joint funding program.

Further Strengthening State Secrets Protection Urged

94P60214D Yinchuan NINGXIA RIBAO in Chinese 3 Feb 94 p 1

[Summary] Ma Xiguang [7456 6932 1639], member of the Autonomous Region's Standing Committee of Communist Party, and Bai Zhenhua [4101 2182 5478], Director of Secrets Protection Committee of Communist Party, stressed at the secrets Protection meeting, which was held on 31 January, that in this new era of reform and opening up, China's secrets protection work should be enhanced, and definitely not be curtailed, in order to better serve China's economic construction. Bai pointed out that by and large, the autonomous region is doing good job in protecting the state secrets. It has done a lot of work to promote secrets protection, such as propaganda and education, popularization of secret protection law, seminars on managing exportation of state secrets, drawing up secrets protection regulations and system, and popularization of secrets protection technologies.

China Enjoying Brisk Technology Market

94P60214E Beijing RENMIN RIBAO in Chinese 2 Feb 94 p 3

[Summary] China's technology market continues to flourish under the guidance of State open and deepening reform policies. In 1993, total volume of business from technology contracting reached 20.755 billion yuan, increased by 37.42 percent from 1992. State data indicated that the technology market not only promoted national economy, but also showed that China's technology market is entering into a new development era. According to statistics gathered from 34 provinces, municipalities, and autonomous regions, with the exception of Tibet and Shenzhen, in 1993 business volume of technology contracts in 25 regions exceeded 100 million yuan. Beijing ranked on top of the nation, with business volume reaching 3.559 billion yuan and a net increase of 428 million yuan. Net increase from technology contracts in Liaoning, Shanghai, Jiangsu, Zhejiang, Hunan, Guangdong and Sichuan also exceeded 300 million yuan in 1993. Statistics also showed that in 1993, China's overall trade level of technology market was greatly elevated, and scope of technology trade was also expanded, the average contracting price per item increased 31.68 percent, from 64,080 yuan in 1992 to 84,380 yuan in 1993. The facts reflect that China has made great progress in promoting its products' quality for international competition.

Advanced Materials and Superconductivity

Effect of Cr on Microstructure of Ti_3Al+TiAl Alloys

40100057A Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 30 No 3, Mar 94 pp A97-A103

[English abstract of article by Zheng Yunrong of the Institute of Aeronautical Materials, Beijing, Zhao Linruo of the Institute for Aerospace Research, Ottawa, Canada, and Tangri Kris of the University of Manitoba, Winnipeg, Canada; MS received 21 Jun 93]

[Text] As-cast microstructure and its changes during heat treatment for Ti-44.9Al(at.-%) and Ti-44.3Al-3Cr(at.-%) have been investigated. The addition of Cr increased the amount of TiAl (γ) phase in the binary Ti-Al alloy and changed the α_2 lamellae into block shaped particles. Cr accelerated the discontinuous coarsening process of the lamellar α_2+γ, by which the finer new-growing lamellar grains were formed. Therefore, addition of Cr and long-time heat treatment at 1150°C are an effective way to refine the large lamellar grains of α_2+γ in as-cast alloy. Cr promoted the formation of an ordered bcc β_2 phase.

Transformation Kinetics, Coarsening of Lamellar Structure in γ-TiAl Alloy

40100057B Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 30 No 3, Mar 94 pp A117-A123

[English abstract of article by Tian Huahang, Huang Zheng, and Chen Changqi of Beijing University of Aeronautics and Astronautics, and Lin Jianguo of the University of Xiangtan; MS received 5 Apr 93, revised 28 Sep 93]

[Text] Transformation mechanism and discontinuous coarsening of lamellar structure were studied by cooling Ti-47.8at.-%Al alloy from α region to room temperature and then aging in the two-phase region. The lamellar transformation process relates to aging temperature and cooling rate, at which α_2 single phase forms. A model of lamellar transformation kinetics was developed. The stability of lamellae decreases with decreasing interlamellar spacing and discontinuous coarsening occurs during aging.

Micro-Mechanical Analysis of Thermal Misfit of Single-Crystal Ni-Base Superalloy

40100057C Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 30 No 3, Mar 94 pp A124-A132

[English abstract of article by Yue Zhufeng and Zheng Changqing of Northwestern Polytechnical University, Xian; MS received 2 Apr 93, revised 24 Sep 93]

[Text] Based on the micro-structural feature of single-crystal Ni-base superalloy, two micro-models have been proposed to calculate and analyze its thermal misfit, especially the critical resolved shear stress of the two-phase superalloys. The results show that the macro-critical resolved shear stress can be obtained by the finite-element method which takes thermal misfit into consideration, and the method can be used to analyze further the superalloys with high γ' volume. The effect of thermal misfit on change of γ' on tempering condition, and the primary quantitative result shows that the thermal misfit stress is one of the main driving forces on γ' coarsening.

Microstructure, Phase Transformation During Annealing of Rapidly Solidified Al-Fe-Ti-C Alloy

40100057D Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 30 No 3, Mar 94 pp A133-A138

[English abstract of article by Tong Xingcun and Shen Ningfu of Zhengzhou Institute of Technology, and Liu Baicheng of Qinghua University, Beijing; MS received 3 Aug 93, revised 6 Sep 93]

[Text] The microstructure and phase transformation during annealing of rapidly solidified Al-Fe-Ti-C alloy have been studied by TEM, EDS and EELS. The initial microstructure consists mostly of α-Al, Al_6Fe particles and a smaller volume fraction of an amorphous phase. During annealing, the amorphous phase transforms into α_1-AlFeSi phase, the globular particles of Al_6Fe growth up and some needle-like Al_3Fe phase precipitates near the α-Al grain boundaries. At 673 K, 96 h and 773 K, 5 h annealing, the Ti and C dissolved in the α-Al during rapid solidification precipitates as a compound phase of $TiC_{0.79}$. The formation process of TiC phase is discussed.

Oxidation Behavior of Sputtered Micro-Grained Superalloy K17F at High Temperatures

40100057E Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 30 No 3, Mar 94 pp B109-B115

[English abstract of article by Lou Hanyi of the Corrosion Science Laboratory, Institute of Corrosion and Protection of Metals, CAS, Shenyang, and Tang Youjun, Sun Xiaofeng, and Guan Hengrong of the Institute of Metals Research, CAS, Shenyang; MS received 21 July 93, revised 5 Sep 93]

[Text] The microcrystalline layer of superalloy K17F was produced by planar magnetron sputtering technique. The microcrystalline layer has homogeneous structure and very fine grain size (less than 0.1 μm) consisting of only γ-phase, while the cast alloy is composed of γ, γ' and carbides. The oxidation resistance of the microcrystalline layer was much better than that of the cast K17F alloy, and was even superior to that of the aluminized

alloy. At first, the oxide scales formed on the cast K17F alloy were composed of mainly Al_2O_3 with small amounts of Cr, Ti and Ni oxides. However, after 500 h oxidation, the content of Al_2O_3 in the oxide scales reduced because of its spallation during exposure, and the oxide scale was mainly composed of Cr_2O_3 and TiO_2. On the contrary, the oxide scale formed on the microcrystalline layer of alloy K17F was found to consist of only α-Al_2O_3 which had excellent adhesion and did not spall in the duration of exposure. The beneficial effects of microcrystallization on the oxidation resistance of the superalloy are briefly discussed.

Invar Effect of Amorphous $Fe_{90-x}Co_xZr_{10}$ Alloys

40100057F Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 30 No 3, Mar 94 pp B126-B129

[English abstract of article by Lu Zhichao and Xianyu Ze of Northeastern University, Shenyang, Li Jizhou, Ye Chuntang, Li Zhuqi, and Kang Jian of the Institute of Atomic Energy, Beijing, Shen Baogen of the Institute of Physics Research, CAS, Beijing, and Lu Mangqi of the Institute of Metals Research, CAS, Shenyang; MS received 26 Feb 93, revised 10 Aug 93]

[Text] The magneto-volume effect and the generalized phonon densities of states for amorphous $Fe_{90-x}Co_xZr_{10}$ alloys have been studied. The average number of valence electrons N_{eff} dependences of the spontaneous magnetostriction ω_S and the average magnetic moment $\bar{\mu}_{FeCo}$ have been obtained, and it has been found that the ω_S takes a maximum at N_{eff} = 8.1-8.2 where the $\bar{\mu}_{FeCo}$ begins to decrease drastically. The generalized phonon densities of states (PDOS) were deduced from inelastic neutron scattering experiments, and the phonon softening phenomenon in amorphous Invar alloy was observed from phonon spectra.

Aerospace

China To Build Asia's Largest Transonic Wind Tunnel

94P60240 Beijing KEJI RIBAO in Chinese 18 Apr 94 p 1

[Text] China is about to embark upon the construction of the largest transonic wind tunnel in Asia. The contract-signing ceremony for the construction of the facility took place in Chengdu on 15 April [1994]. Vice Minister Shen Chunnian of the Commission of Science, Technology and Industry for National Defense and Ma Lin, deputy governor of Sichuan Province were among those who attended the ceremony.

The wind tunnel is an indispensable piece of ground simulation equipment for research on aircraft and space vehicles and provides aerodynamic data on these flying bodies under different speeds and flight conditions. It is possible to satisfy the requirements for aerodynamic testing of flying bodies only with a large-scale wind tunnel that provides realistic model aircraft, good flow field conditions and high measurement accuracy.

Biotechnology

Liver Cancer Vaccine Developed

94P60215A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 5 Mar 94 p 3

[Summary] A liver cancer vaccine that can induce the immune system to produce antibodies to recognize liver cancer cells and kill them, has been jointly developed and successfully tested in white rats by the Eastern Institute of Liver and Gall Bladder Surgery of the Shanghai Second Military University and the U.S. Case Western Reserve University (CWRU). The scientists fused the liver cancer cells and the activated B cells, both were obtained from white rats, to produce new hybrid cells (vaccine). After being injected back into the white rats, the hybrid cells (vaccine) induce the rat's immune system (B-Cells) to produce antibodies, which can automatically recognize the cancer cells and kill them. Test results indicated that white rats receiving injections of both newly-developed hybrid cells (vaccine) and cancer cells at the same time have survived, those receiving only cancer cells died within 60 days. The hybrid cells can prevent cancerization of normal cells as well. It is the first successful research worldwide to use immune cells (B cells) to develop vaccine. The achievement has laid the foundation for using vaccines to prevent and treat liver cancer.

Daxing New Drug Development and Testing Base

94P60215B Beijing RENMIN RIBAO in Chinese 2 Feb 94 p 3

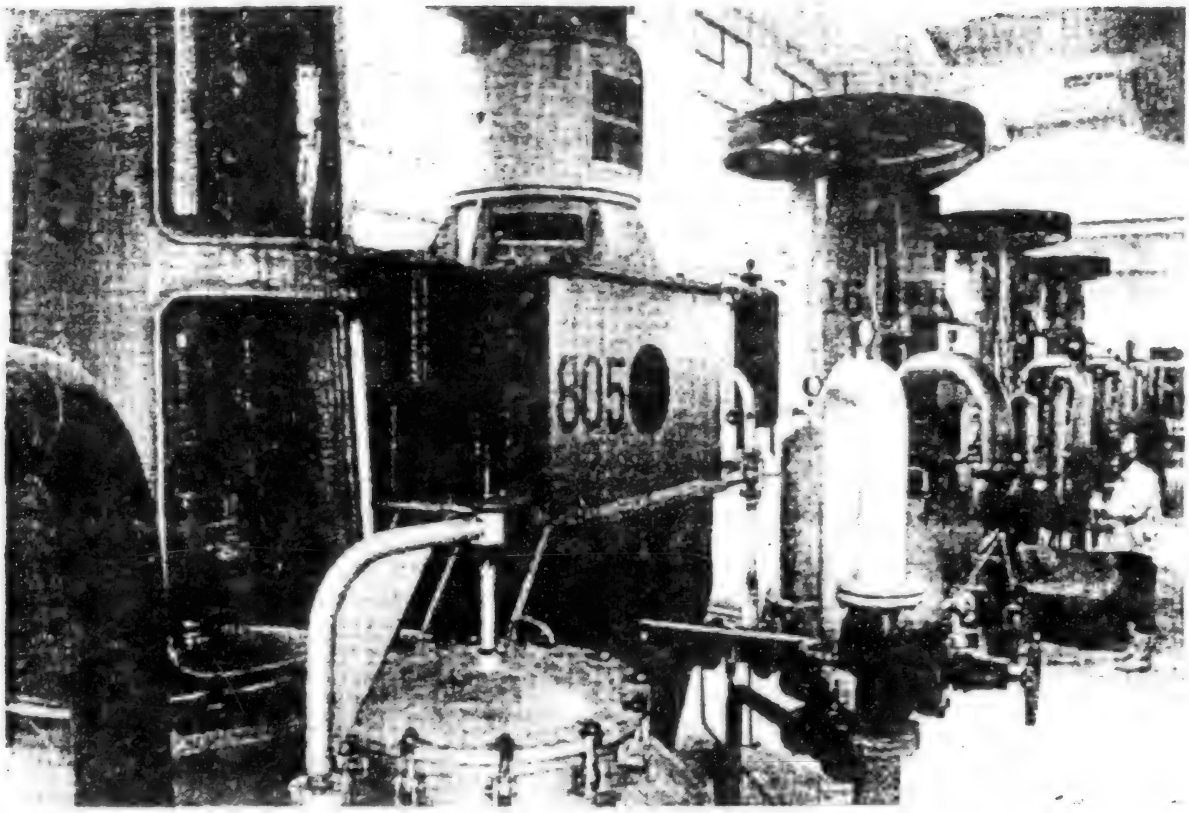
[Summary] Recently a new drug testing center, the Daxing New Drug Development and Testing Base, was completed and passed assessment. In order to promote competition in the international market of new drugs produced in China, the State Government had included this key industrial testing program under the 'Seventh 5-Year Plan' key technology projects. The testing base occupies an area of five hectares with a total investment of 30 million yuan. The program will focus on research and development (R&D) of new drugs, and production of them in various forms including vials, tablets, capsules, drops, suppositories, and lyophalized powder to facilitate sales in the international market.

World's Largest Antibiotics Production Plant Built in Fujian

94P60215D Fuzhou FUJIAN RIBAO in Chinese 10 Mar 94 p 2

[Photo taken by Zhu Wenguang [2612 2429 0342]]

[Caption] The world's largest aureomycin production line, the Fuzhou Antibiotics Manufacturing Plant's "555



Project," is a cooperative effort of the State, Fujian Province and Fuzhou City. This key technology reform project was officially put into operation on 24 January 1994. Projected annual production of aureomycin is 800 tons, and its estimated annual profit from taxation will be over 10 million yuan. This picture shows the internal structure of the plant.

Research on Primary Structure of Scorpion Neurotoxin (BmK IT2)

94P60215C Beijing KEXUE TONGBAO [CHINESE SCIENCE BULLETIN] in Chinese Vol 39 No 3, Feb 94 pp 269-272

[Article by Ji Yonghua [0679 3057 5478] and Xu Ke [1776 4430], Shanghai Institute of Physiology, Chinese Academy of Sciences, and Susumu Terakawa, Okazaki National Institute of Physiology, Okazaki, Japan. The project was supported by the National Natural Science Foundation of China and partially supported by the International Cooperation Project of the Ministry of Education of Japan.]

[Abstract] After successfully sequencing the contracting neurotoxin BmK IT and the flaccid paralysis neurotoxin alpha-BmK IT (BmK IT) isolated from the East Asia scorpion Buthus martensi Karsch, further study on the primary structure of scorpion neurotoxin BmK IT2 was carried out. Shown in Figure 2 is the comparison of complete amino acid sequences of BmK IT2 and other neurotoxin analogs.

Computers

Three Bases Completed by CAS Machine Translation Center

94P60249A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 6 Apr 94 p 3

[Article by Zhang Yulai [1728 3768 0171]: "CAS Machine Translation Center Completes Construction of Three Bases"]

[Summary] Beijing, 4 Apr—It has been learned from the Chinese Academy of Sciences (CAS) that since world-renowned young machine translation scholar Dr. Chen Zhaoxiong began to direct the CAS Computer Institute's Machine Translation Center (MTC) in November 1992, CAS has completed construction of two other MTCs. The three domestic centers now specialize in the following areas: research in information science, production and development of machine translation systems (MTSs), and technical training, respectively.

The two new centers have already taken on over 10 research projects including State 863 Program key tasks, NSFC key tasks, and international and domestic cooperative projects. The centers have admitted into their

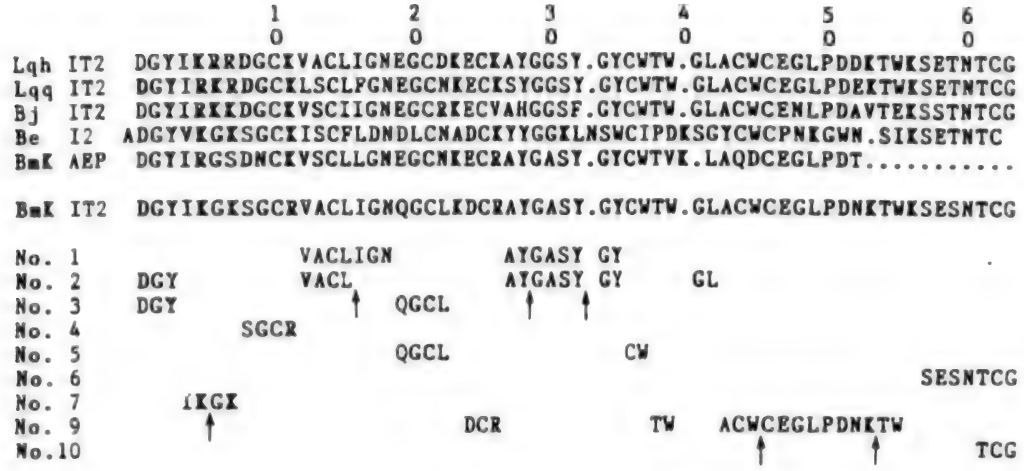


Figure 2. Comparison of Complete Amino Acid Sequences of BmK IT2 and Other Toxins

Table 1. Comparison of Amino Acid Components of BmK IT2 and Other Toxins

Amino acid	BmK IT2 (native)	BmK IT2 (sequence)	Lqh[a)] IT2	Lqq[a)] IT2	Bj[a)] IT2
Asx	7.70(8)	6	7	6	6
Thr	2.44(3)	3	4	4	4
Ser	3.84(4)	4	2	4	4
Glx	3.37(3)	3	4	5	4
Pro	1.10(1)	1	1	1	1
Gly	8.10(8)	10	10	10	9
Ala	3.00(3)	4	3	1	3
1/2Cys	-(8)	8	8	8	8
Val	1.65(2)	1	1	0	3
Met	0.00(0)	0	0	0	0
Ile	1.55(2)	2	2	1	3
Leu	3.48(4)	4	3	4	2
Try	4.18(4)	4	4	4	2
Phe	0.00(0)	0	0	1	1
Lys	4.58(5)	5	6	6	5
His	0.00(0)	0	0	0	1
Arg	1.65(2)	2	2	2	2
Trp	N.D.[b)]	4	4	4	3
Sum Total	57	61	61	61	61

a) Lqq IT2, Bj IT2, Lqh IT2 Taken from reference [5]

facilities over 100 invited guests and cooperative research fellows from Beijing University, Qinghua University, and 16 other higher-learning institutions and research institutes. With 863 Program support, Dr. Chen and his colleagues have developed a number of MTSs including English-Chinese, Chinese-English, Russian-Chinese, and German-Chinese. The Kuai Yitong 863 series of MTSs, developed and marketed in cooperation with Hong Kong's Quanzhi [2938 2535] Company, are now in mass production with a scale indicated by annual sales of 600 million yuan, direct benefits of $5.1 million to the State, and fixed assets of over $8 million. A while back, the original CAS MTC pooled its research talent with Quanzhi's investment capital to form the joint venture Shenzhen Kezhi [4430 2535] ("Sci-Sense") Language Information Processing Ltd., the strongest and richest language information processing industrial base. The third base or center, specializing in technical training, admitted 12 MS candidates and 1 Ph.D. candidate last year, and this year will admit an additional 10 master's students and 4 Ph.D. students.

First Domestic Remote-Sensing Image Processing Software System Developed

94P60249C Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 18 Apr 94 p 2

[Article by Hu Zuo [5170 1563]: "China Develops First RIPS Processing Software"]

[Summary] After a year of trial use with satellite-captured data, the nation's first domestic workstation RIPS (remote-sensing image processing system) processing software, developed in 1992-1993 by the Inner Mongolia Remote Sensing Center (IMRSC) has proven more flexible than a large number of comparable imported systems in use here in China. This software system, which operates via windows interfaces throughout, will save on State outlays for such imported systems, which cost several hundred thousand dollars. It is understood that IMRSC has just finished development on a second-generation RIPS.

Interview with Fuzzy Logic Expert Prof. Wang Peizhuang

94P60249B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Apr 94 p 4

[Article by Tang Dongning [3282 2639 1337]: "Knowledge Engineering: A Key to 21st-Century S&T Development"]

[Summary] This writer is fortunate to have been granted an interview with fuzzy mathematics theory and applications specialist Prof. Wang Peizhuang [3076 1014 8369] of the Fuzzy Mathematics Institute at Beijing Teachers' University. This world-renowned scholar, China People's Political Consultative Committee member and concurrently China Branch Director of the International Fuzzy Systems Association (IFSA), expounded on the history of fuzzy mathematics theory and applications in China and on the bright prospects for applications of fuzzy logic in the S&T of the coming century. One of the specific benchmarks he brought up was his research team's development of the world's second prototype computer built with fuzzy inference engine discrete components; Dr. Wang's team achieved a 50 percent increase in speed [from 10 million inferences per second to 15 million inferences per second] and a reduction of 90 percent in the machine's physical volume compared to the world's first such prototype, developed by Japanese Professor Takeshi Yamakawa and announced on [11 July] 1987 [details in JPRS-CST-88-014, 25 Jul 88 pp 116-117 and in JPRS-CST-90-027, 29 Oct 90 pp 13-14]. Dr. Wang also mentioned China's world-class research on fuzzy control of inverted pendulums [details in JPRS-CST-92-012, 18 Jun 92 p 53]. Finally, he stressed the value of knowledge engineering in future development of a variety of disciplines, including weather forecasting, seismology, industry (especially metallurgy), home electronics, economic planning, management, transport, banking and finance, and education.

Defense Technology

Real-Time Polarization-Diverse Feature Extraction, Automated Aircraft Target Identification via Neural Network

94P60235A Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 22 No 3, Mar 94 pp 113-115, 119

[Article by Zhang Liangjie [1728 5328 2638] of the Dept. of Automation, Qinghua University, Beijing 100084, and Wang Wenbing [3076 2429 4426] of the Dept. of Information & Control Engineering, Xian Jiaotong Univ., Xian 710049: "Real-Time Polarization-Diverse Feature Extraction, Automated Target Identification of Radar Aerial Targets via ANN Techniques"; MS received Jul 92, revised Jun 93]

[Abstract] A method that maps the polarization-diverse feature extraction problem onto the Liapunov energy function of the Hopfield linear programming additive neural network (ANN) is presented to obtain a real-time solution of these features derived from the polarization ellipse corresponding to the major scattering centers. Then these features are transformed to enable free use of Carpenter and Grossberg's ART2 [Adaptive Resonance Theory 2] ANN for automated radar target identification of aircraft.

In the computer simulation experiment, the total number of learning patterns selected was eight and the number of input features was six (three parameters each for the engine inlet and the tail); after numerous self-regulation training cycles, the technique was able to accurately recognize four aircraft targets—Concorde, DC-10, 707, and 747—with a minimum warning line (i.e. threshold value) of 0.3. The one figure shows the polarization ellipse, while the one table compares values for the six features of all four aircraft calculated via reference [1] with those calculated by the authors' method.

References

1. N.E. Chamberlain, E.K. Walton, E.D. Garber, "Radar Target Identification of Aircraft Using Polarization-Diverse Features," IEEE TRANS., 1991, AES-27: 58-67.

2. D.W. Tank and J.J. Hopfield, "Simple 'Neural' Optimization Networks: An A/D Converter, Signal Decision Circuit, and Linear Programming Circuit," IEEE TRANS., 1986, CAS-36: 533-541.

3. G.A. Carpenter, S. Grossberg, "ART2: Self-Organization of Stable Category Recognition Codes for Analog Input Patterns," APPLIED OPTICS, 1987, 26: 4919-4930.

4. A.D. Culhane, M.C. Peckerar, C.R.K. Marrian, "A Neural Net Approach to Discrete Hartley and Fourier Transforms," IEEE TRANS. CIRCUITS AND SYSTEMS, 1989, 36,(5): 695-703.

Factory Automation and Robotics

First Domestically Made Laser Rapid Prototyping Machine Unveiled

94P60248B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 11 Apr 94 p 1

[Article by Xie Ning [6200 1337]: "First Domestic Laser Rapid Automatic Forming Machine Unveiled"]

[Summary] China has just realized a breakthrough in advanced manufacturing technology. The nation's first domestically made laser rapid prototyping machine—developed, designed and made by Beijing Longyuan [7127 3293] Enterprises Ltd.—was unveiled the other day in Beijing, and has been put into formal operation. This new unit, model STILY-I, employs the [stereolithography (SLA)] additive technique in which various layers of material are selectively built up into the solid prototype by a laser whose scan sequences are controlled by CAD/CAM databases. The total process includes laser-heated powder sintering [i.e. selective laser sintering (SLS)], induced liquid photopolymer material [cut-out], and induced vapor-phase deposition for gradually building up [and curing] the final solid plastic, ceramic or wax model. [The wax models are then used to create ceramic molds for fabricating final prototype products—FBIS].

New CNC System, CNC Borer/Miller Series Unveiled by Beijing Firm

94P60248A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 7 Apr 94 p 1

[Article by Ji Wen [0679 2429]: "Nanjing Sikai Company Markets New Numerical Control Systems"]

[Summary] At the '94 China Machine Tool & Accessories Trade Exposition held the other day, Nanjing Sikai [0934 7030] Electronic Enterprises Ltd. unveiled its SK-6M numerical control system, as well as the SKY series of CNC boring and milling machines. The SK-6M system, developed around 32-bit general-purpose microcomputer technology, is fully compatible with IBM PCs at both software and hardware levels. System hardware structure is oriented toward PC-bus-based modularized structures. The SK-6M meets requirements for 3-axis CNC all-closed-loop or semi-closed-loop control; the system uses a 1.44 M floppy disk or 40-200 M hard disk for inputting and storage of machining programs.

Lasers, Sensors, Optics

Nuclear-Pumped ^{3}He-Ar-Xe Laser Experiment at CFBR-II Successful

94P60228A Chengdu QIANG JIGUANG YU LIZI SHU [HIGH-POWER LASER AND PARTICLE BEAMS] in Chinese Vol 6 No 1, Feb 94, inside front cover

[Article by Jin Xingxing [6855 5887 2502]: "Nuclear-Pumped ^{3}He-Ar-Xe Laser Experiment Successful"]

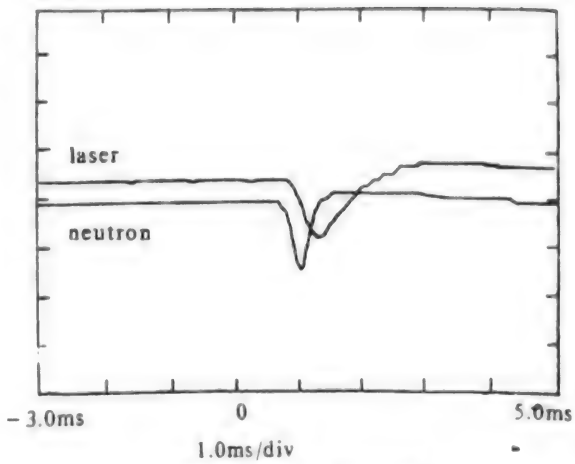


Figure 2: Laser Waveform

[Summary] On 21 October 1993, scientists at the Institute of Nuclear Physics and Chemistry of the Chinese Academy of Engineering Physics (CAEP) conducted a successful ^{3}He-Ar-Xe (wavelength = 1.73 microns) laser experiment at the CFBR-II [China] Fast Neutron Pulsed [Breeder] Reactor facility, achieving laser output at a power of 24 mV [apparently a reference to the voltage level of the oscilloscope waveform, reproduced above—FBIS]. This breakthrough in domestic research on nuclear-pumped lasers also realized a thermal neutron injection rate of 6×10^{14} n/cm^2-s after polyethylene moderation. Based on the moderator structure, we designed an internal gas-filled amplifier tube assembly with the following pressure proportional mix: ^{3}He:Ar:Xe = 3.47×10^4:3.47×10^4:2.67×10^2 (Pa); tube length is 600mm and diameter is 34mm. With about 1.4×10^{16} fissions per pulse, using a plano-concave cavity stabilizer, we did a total of eight shots in the experiment and the results of all eight firings are essentially in agreement. The observed waveform is shown below in Figure 2 [Fig. 1, not reproduced, shows a photograph of the experimental apparatus].

Bipulse-Drive-Generated High-Gain X-Ray Laser Experiment Successful

94P60228B Chengdu QIANG JIGUANG YU LIZI SHU [HIGH-POWER LASER AND PARTICLE BEAMS] in Chinese Vol 6 No 1, Feb 94, inside back cover

[Article by Sun Yongliang [1327 3057 5328]: "Bipulse-Drive-Generated High-Gain X-Ray Laser Experiment Successful"]

[Summary] From 20 October to 19 November 1993, scientists at Laboratory 214 of the Southwest Institute of Nuclear Physics and Chemistry (SINPC) conducted a series of X-ray laser experiments. Using the LF-12 laser facility, and guided by X-ray laser theoretical research done at the Beijing Institute of Applied Physics and Computational Mathematics, the SINPC scientists successfully observed two electron-collision-excited Ne-like Ge X-ray laser gain lines—one at 19.6 nm and one at

23.6 nm. The scientists used a narrow-pulse-width, low-energy bipulse laser drive and a thin-film target. In electron-collision-excited mechanism research, this is the first report worldwide of successful realization of high-gain X-ray lasing with a low-energy, mid/high-power-density laser.

Nonlinear Processes From Interaction of 1.053 μm Laser With Hohlraum Targets

40100059A Chengdu QIANG JIGUANG YU LIZI SHU [HIGH-POWER LASER AND PARTICLE BEAMS] in Chinese Vol 6 No 1, Feb 94 pp 5-15

[English abstract of article by Mei Qiyong, Zhao Xuewei, et al. of Southwest Institute of Nuclear Physics and Chemistry, No 77, P.O. Box 525, Chengdu, 610003; MS received 20 Oct 92, revised 20 Aug 93]

[Text] Abundant nonlinear processes may be produced in submillimeter-size hohlraum targets by 1.053 μm laser light with duration of 1 ns and energy of 300-600 J. In experiments, Stimulated Brillouin Scattering (SBS) and Stimulated Raman Scattering (SRS) were directly measured, and Resonance Absorption (RA), Two-Plasmon Decay (TPD), and Ion Acoustic Decay (IAD) were observed indirectly. The experimental results show that SBS and SRS are the dominant nonlinear processes in cavity; they can scatter about 40 percent of the incident laser energy. Electron plasma waves stimulated by nonlinear processes such as SRS, TPD, RA, and IAD are the sources of suprathermal electron generation. Our research indicates that SRS is the chief process for electron plasma-wave generation in hohlraum targets, and it can produce suprathermal electrons with a total energy about 10 percent of incident laser energy. Because spectra of nonlinear process scattering light are closely related to the plasma state, we can obtain information about the plasma state through intensive measurement and analysis of these spectra of the scattering light.

CW Chemical Oxygen Iodine Laser Using Extracavity Power Output

40100059B Chengdu QIANG JIGUANG YU LIZI SHU [HIGH-POWER LASER AND PARTICLE BEAMS] in Chinese Vol 6 No 1, Feb 94 pp 45-48

[English abstract of article by Zhou Dazheng, Sun Long, et al. of the Dalian Institute of Chemical Physics, CAS, Dalian 116023; MS received 5 Jan 93, revised 5 Apr 93]

[Text] We developed a CW chemical oxygen iodine laser (COIL) using extracavity power output which has obtained small-signal gain of 1.6×10^{-3} cm^{-1}. Under the conditions that the Cl_2 flow rate is 30 mmol/s, the I_2 flow rate is 0.3 mmol/s and the cavity pressure is 200 Pa, the power outputs of linearly polarized light were obtained from the experimental data: maximum values of power output are 178W at the half extracavity and 70.4W at the full extracavity.

First Domestic Ozone LIDAR Operational

94P60247A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 4 Apr 94 p 1

[Article by Peng Dejian [1756 1795 1696]: "China Puts into Operation First Ozone Laser Radar"]

[Summary] Hefei (ZHONGGUO KEXUE BAO wire report)—The nation's first ozone laser radar (LIDAR) was put into operation on 28 December 1993. In the 2-odd months since then, this ozone LIDAR has provided a set of data on the vertical distribution of the ozone concentration in the 15-40-km altitude range. The results obtained by the researchers so far coincide with those obtained by scientists in the U.S., Japan, and other countries. This ozone LIDAR was developed by CAS Anhui Institute of Optics & Fine Mechanics (AIOFM) Research Fellow Hu Huanling [5170 2970 7117], supported by grants from the 863 Program and the NSFC. Researcher Hu used AIOFM's independently developed excimer laser and a double-wavelength operating system with a YAG [yttrium-aluminum garnet] frequency tripled output to conduct differential absorption LIDAR (DIAL) measurements of the ozone.

High-Power CNC YAG CW Solid-State Laser Processing Unit Certified

94P60247B Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 4 Apr 94 p 3

[Article by Shu [2579]:"High-Power YAG Continuous-Wave Solid-State Laser Processing Unit Developed"]

[Summary] In a 3-year effort, MEI's Institute 11, the Tianjin Textile Institute, and Beijing Tonghai [6639 3189] S&T Development Corporation have jointly designed and constructed the nation's highest power CNC YAG continuous-wave (CW) solid-state laser processing machine, which the experts have just certified to meet current international standards for main performance indicators. As measured by the experts, this unit has a laser output average power of 500 W, a maximum power of 800 W, and a maximum continuous operation time of over 8 hours.

Mobile Neutron Radiography System Certified

94P60247C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 14 Apr 94 p 3

[Article by Chen Meifeng [7115 5019 7685]: "Major Breakthrough in Neutron Radiography Technology"]

[Summary] Changchun, 13 Apr (XINHUA) A miniature portable neutron radiography system with applications in national defense, aerospace, and other leading edge scientific areas was recently developed by the Physics Deparment at Northeast Teachers' University (NTU) and just passed formal appraisal here in Changchun. This non-destructive testing equipment, heavier forms

of which have long been used for nuclear reactor monitoring, can now be conveniently used out in the field for a variety of other tests. The key to the completion of this task, which the NTU researchers took over 6 years ago from the National Defense Science, Technology and Industry Commission, was the development of the scintillation augmentation screen, whose main performance parameters—especially imaging speed and resolution—have been certified by the experts to meet the best current international standards. The system, which has a sealed neutron source tube, can take either film photographs or can send low-light-level cumulative images to a computer for further enhancement.

Microelectronics

Domestic Development of 0.50-Micron LDD PMOS Technology Reported

94P60227A Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 22 No 2, Feb 94 pp 96-99

[Article by Yu Shan [0151 1472], Institute of Computer Application and Simulation Technology, Second Research Academy, Ministry of Aerospace Industry, Beijing 100854, and Zhang Dingkang [4545 1353 1660] and Huang Chang [7806 2412] of the Shaanxi Microelectronics Institute, Lintong 710600: "Development of 0.50-Micron LDD PMOS Technology"; MS received Nov 92, revised Jan 93]

[Abstract] To develop high-reliability submicron VLSI circuits, it is necessary to suppress the serious PMOS [p-channel metal oxide semiconductor] hot-carriers effect. Our investigation of the 0.50-micron LDD [lightly doped drain] PMOS process indicates that the LDD can greatly suppress the hot-carriers effect, short-channel effect, and the hot electron-induced punch through (HEIP) effect in the PMOS material. Finally, we have developed an optimum LDD PMOS process and have applied it to fabricate 0.50-micron ICs.

On N (resistivity = 1-2 ohm-cm) silicon wafers, we have adopted the PMOS process. After polysilicon-gate fabrication (gate oxide layer thickness of about 28 nm), we did the LDD preparation with the following process flow chart:

(a) BF_2^+ implantation to form lightly doped P^- region; implantation dose = 7×10^{12}-$8 \times 10^{13}/cm^2$, implantation energy = 25-60 keV.

(b) LPCVD [low-pressure chemical vapor deposition] SiO_2, 400 nm.

(c) CHF_3 RIE [reactive ion etching] SiO_2 to form 0.20-nm $Si0_2$ side wall.

(d) Side-wall mask BF_2^+ heavy implantation to form S/D P^+ doping; implantation conditions: 40 keV, $2 \times 10^{15}/cm^2$.

(e) Annealing for 30 min at 950° C to form the LDD structure.

After this, a conventional CMOS [complementary metal oxide semiconductor] process is used to complete device fabrication.

Using this optimized PMOS LDD process combined with an optimized NMOS LDD and a self-aligned titanium-silicide process, we have developed a set of submicron CMOS processes. ICs fabricated with this process include a 0.5-micron voltage-controlled oscillator [VCO] with a 600 MHz speed and a gate delay of 130 ps [picoseconds], as well as other submicron circuits, with very good results [refs. 11-12].

Five figures show various relationships among device parameters. There are no tables.

Selected references [from total of 12]:

11. Yu Shan, Zhang Dingkang, Huang Chang, "Optimized Design, Development of Submicron LDD MOSFET Integrated Circuits" (in Chinese), BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS], 13(7): 423-429 [abstracted in JPRS-CST-92-017, 24 Sep 92 p 39].

12. Yu Shan, Zhang Dingkang, Huang Chang, "Development of 0.5-Micron CMOS Integrated Circuit Technology," Proc. 3rd Int. Conf. ICICT, Beijing: China Electronics Industry Publ. House, 1992: 143-146.

70 Achievements of MEI Institute 13 Certified

94P60227B Beijing DIANZI XUEBAO [ACTA ELECTRONICA SINICA] in Chinese Vol 22 No 2, Feb 94 p 34

[Unattributed article: "70 Research Achievements of Institute 13 under Ministry of Electronics Industry Pass Formal Appraisal"]

[Summary] At a formal technical appraisal held 23-25 December 1993, 70 research achievements of MEI's Institute 13, located in Shijiazhuang, were certified. Technical details are as follows:

1. Silicon Microwave Devices

Breakthroughs in 1993 were realized in development of broadband high-power devices such as the WD942 silicon broadband microwave pulsed power transistor, which in the 0.96-1.215-GHz range has a pulsed output power of 100 W and a pulse width of 10 μs, and the WD951 device, which in the 2.25-2.55-GHz range has a pulsed output power of 50 W and pulse width of 65 μs.

2. Optoelectronic Devices

Advances have been made in research on high-power quantum-well laser diodes especially applicable to domestic all-solid-state lasers. Last year, the institute developed AlGaAs and InGaAs quantum-well laser

diodes for solid-state laser pump sources—an achievement closely tracking the world state-of-the-art.

3. Micropackaging, Microassemblies/Micromodules

In development of micropackaged devices, microassemblies and micromodules, the institute has made advances meeting early-90s international standards. The HE481-487 miniature VCO IC meets late-80s international standards.

4. Process Technologies

In 1993 the institute undertook 10 military-product early-phase research projects, among which outstanding achievements were development of an all-planar process for fabricating the model E/D 2000-gate GaAs gate-array device and development of performance evaluation theory and methods for hardening and ruggedizing devices.

High-Sensitivity, Low-Dark-Current GaAs Quantum Well Infrared Photodetectors

40100058A Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 15 No 3, Mar 94 pp 188-193

[English abstract of article by Zhong Zhantian, Zhou Xiaochuan, Du Quangang, and Zhu Qinsheng of the Laboratory for Surface Physics, CAS, Beijing 100080, Wu Ronghan, Wang Sen, Li Chengfang, and Xu Junying of the Institute of Semiconductors, CAS, Beijing 100083, and Zhou Dingxin and Yu Meiyun of Shanghai 803 Research Institute, the Ministry of Aero-Space Industry, Shanghai 200233; MS received 15 Jun 92]

[Text] Long-wavelength GaAs quantum well infrared detectors have been demonstrated and evaluated. The detectors are comprised of 50 GaAs quantum wells and $Al_{0.28}Ga_{0.72}As$ barriers. The detectors were fabricated by etching a 320-μm-diameter mesa. We have achieved a detector responsivity $R_v = 9.7 \times 10^5$ V/W and a high detectivity at peak wavelength in excess of 1×10^{11} cm-$(Hz)^{1/2}$/W at 9.2 μm; device dark current is lower than 0.1 μA at an operating temperature of T = 77K.

Micro-Submicrometer P-MOSFETs Fabricated Using Electron-Beam Doping Technique

40100058B Beijing BANDAOTI XUEBAO [CHINESE JOURNAL OF SEMICONDUCTORS] in Chinese Vol 15 No 3, Mar 94 pp 204-207

[English abstract of article by Li Xiuqiong, Hai Chaohe, and Yang Jun of the Microelectronics Center, CAS, Beijing 100010; MS received 28 Jun 93, revised 16 Sep 93]

[Text] Micro-submicrometer [5,3,1, and 0.7 μm] P-MOSFETs have been investigated using a recently developed electron-beam doping technique. It is shown that the doping technique can be used for fabrication of micro-submicrometer MOSFETs. The P-MOSFETs fabricated show excellent device properties: smaller leakage, good I_d-V_d characteristics, shallow and uniform junction depth and smaller effect of lateral doping for drain and source. This doping technique is compatible with conventional MOS technology. Furthermore the equipment used is not very complicated and expensive, and the process is very simple. Therefore it is a very promising technique for fabrication of devices, especially for VLSI processing.

New DRAM Manufacturer to Start Up in Taiwan; ITRI to Become Enterprise

94FE0432A Tokyo NIKKEI MICRODEVICES in Japanese No 3, March 94 pp 78-79

[Article: "New DRAM Manufacturer to Be Created in Taiwan: Government Research Organization Will Become an Enterprise"]

[Abstract] A new DRAM manufacturer will be created in Taiwan. Deputy director Chintay Shih of the governmental Industrial Technology Research Institute (ITRI) revealed plans to establish a new DRAM-producing company. The Electronics Research and Service Organization (ERSO), one of ITRI's departments, will be the parent body of the new manufacturer. It has completed the development of a new 16-MB DRAM chip using 0.5-micron technology. The process will use 200-mm wafers. The production line created by ERSO for trial production of the chip will be expanded for full-scale production purposes. The manufacturing facility is located in the Hsinchu High-Technology Park. The name of the company, the size of its investment, and the annual output, are still undecided. The possibility of a funding consortium consisting of several manufacturers is now being explored.

ERSO is one of 11 subdivisions of ITRI. Its Submicron Project includes 0.5-micron CMOS (16 MB DRAM) development and also 0.35-micron and smaller CMOS development by National Nanodevice Laboratories, established in 1992.

The 0.5-micron 16-MB DRAM chip was designed by Etron Technology of Taiwan. Etron's founder, Nicky C. C. Lu, is a former IBM DRAM designer. According to Mr. Lu, the 16-MB DRAM chip is a first-generation chip, with an area of 100 mm^2, in a 400-mil package. A stacked memory cell design will be used. The technology for the more recent trench process is not yet available in Taiwan. The second-generation chip will be a synchronous DRAM for high-speed data transmission. An attempt will be made to use the "lead-on-chip" (LOC) technology. The search for an existing manufacturer who can implement this technology is now under way.

The TI-Acer company of Taiwan is now producing 4-MB DRAM. In Phase 1 of the Fab 1 stage, 1500 units a month of 0.8-micron technology 150-mm equivalent chips will be produced. Phase 2 is scheduled to get under way in 1995. The total output will be 24,000 units per

month. Mosel Vitelic, a DRAM-oriented company that produces for the Taiwan electrical engineering industry, is setting up a clean room to meet 0.5-micron standards. Operation is expected to begin this year. Taiwan's largest LSI producer, Taiwan Semiconductor Manufacturing Company, Ltd. (TSMC), plans to produce DRAM under the Fab 3 stage, which began in December 1993.

Taiwan's Department of Economics is backing this effort to create a DRAM project from existing enterprises and government research organizations. In December 1992, the department designated 66 systems and components as key projects for stepped-up effort in order to replace imported products. The 66 designated products are grouped into three ranks. Rank A consists of products for which the Department of Economics has created a technology development project team and is carrying on the R&D. Rank B consists of technologies for which a subdivision of the Industrial Office has created a development plan for joint implementation by two or more enterprises. Rank C consists of projects in which enterprises are investing, with government support in order to facilitate production.

Telecommunications

Major Campaign for Information Highways Under Way

KEJI RIBAO Holds Symposium

94P60236A Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 12 Mar 94 p 1

[Article by Tang Dongning [3282 2639 1337] and Yu Xiaohan [0060 1420 2498]: "Meeting the Second Information Revolution Challenge to Battle"; cf. JPRS-CST-94-007, 3 May 94 p 19]

[Summary] Beijing, 11 Mar (KEJI RIBAO report)—Should not China seize the opportunity to formulate policies for yet another "information revolution"—that of the "information highways?" To this end, KEJI RIBAO today convened an Information Highway Expert Symposium; at this forum, the experts unanimously agreed that our nation, faced with a rare opportunity in world history, should quickly take action appropriate to national conditions. These specialists also felt that China, compared to advanced nations—especially the U.S., with its National Information Infrastructure (NII) program—lags behind in economic power, but that China nonetheless should accelerate its strategic in-depth planning and concentrate its attention on this second information revolution that will inevitably foster future economic and social development. Specifically, the experts urged that domestic information resources be disseminated throughout the society, be market-oriented, and incorporate international developments—all in step-by-step, gradually accelerated fashion.

Interview with Legend Group Chief Engineer

94P60236B Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 21 Mar 94 p 1

[Article by Shun Li [7311 0448]: "'Informationization' Is the Road One Must Take for Social Development"]

[Summary] Legend Group Chief Engineer Ni Guangnan [0242 0342 0589] granted this writer an interview to comment on the electronic information changes that are sweeping the nation. Ni noted the "National Economic Informationization" slogan [for the "Golden Bridge Project"] now being proposed by various authorities: it essentially refers to a debate on how to best determine the influence of this [second] "Information Revolution" on 2lst-century S&T development. Ni said that the high-speed information networks now being developed worldwide can bring into reality for mankind the type of things only dreamed about in the past and incorporated in the science fiction novels of the past few decades. In closing, Ni noted that the "Three Golden Projects" now being implemented under State direction are without question the proper direction that China should take and will inevitably promote domestic S&T development into the next century.

MPT Building Public Digital Data Network

94P60236C Beijing ZHONGGUO DIANZI BAO [CHINA ELECTRONICS NEWS] in Chinese 21 Mar 94 p 3

[Article by Xing You [5281 1429]: "Nation to Build Public Digital Data Network"]

[Summary] To implement an "Information Highway" and to provide high-speed data communications, MPT is now building a national public digital data network (DDN). In this DDN project, MPT will import from Canada a 3600 bandwidth management system and from the U.S. some DACS 11-2000 digital cross-connect (DXC) equipment. DXC node computers will be installed in 24 provinces and municipalities nationwide. The main channels of this DDN are scheduled to be completed and operational by July of this year. DDN users will be provided with digital channels for data/image/videoconference transmission services at a variety of bit rates up to and including 2 Mbps, and will have trans-provincial transmission capabilities via public telecommunications networks, packet-switching networks, and local/provincial-level DDNs now being built.

MPT Holds Forum

94P60236D Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 25 Mar 94 p 1

[Article by Ji Hongguang [1323 3163 0342]: "MPT Organizes Experts to Discuss Nation's High-Speed Information Network Construction"]

[Summary] A few days ago, MPT held a forum in Beijing on "Building China's High-Speed Information Networks." At the forum, dozens of academicians, professors, senior engineers, and high-level managers from the fields of computers, communications, and automation offered their proposals on how best to implement domestic information highways. Officials from MPT's Planning Department and Directorate-General of Telecommunications informed the experts of the status and development plans for the national communications networks. MPT Science and Technology Committee Chairman Song Zhiyuan [1345 4160 0337] remarked that the people's economic information infrastructure for the national network of information highways will principally consist of two major components: communications platforms in the public sector and applied information systems for various authorities.

SSTC Chief Engineer Urges Developing Infrastructure

94P60236E Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 1 Apr 94 p 1

[Article by Ji Fusheng [0370 1788 3932], Chief Engineer, State Science and Technology Commission (SSTC), Department for Basic Research and High Technology: "Value the Building of an Information Infrastructure"]

[Summary] [Editor's note] Chief Engineer Ji Fusheng was one of the distinguished participants in the "Information Highway" Symposium recently held by KEJI RIBAO. [End of editor's note.]

I feel that planning for information highways has already grasped several key factors in current social development. Up to the year 2020, information technology will remain a hot topic and will remain in a decisive position amid international competition. Setting out from present national conditions, authorities and technologists must focus on building an infrastructure for information services. Building an information infrastructure is an indispensable condition for the people's economic modernization. This new infrastructure is not limited to telephone service, however; modern conditions require that a gradually increasing percentage of all telecommunications services be devoted to data and image transmission. Therefore, in planning for and constructing our national information infrastrucutre, we must start out by meeting the demands of integrated services [i.e., those provided in integrated services digital networks (ISDNs)]. Our domestic campaign is fully capable of incorporating the latest worldwide S&T achievements. In the area of technical progress, China is also fully capable of leaping over several historical stages of development experienced by advanced nations in their development course. At the same time, we must be practical and realistic, and must chart out our path according to scientific research into market demand. The State has already taken some steps in strategic development of an information infrastructure, such as 863 Program support for research on high-speed parallel computing and high-speed communications, but the strength of this R&D effort is still insufficient. The State should firm up its outline for constructing an information infrastructure, utilize existing resources, and make appropriate additions to its financial support for this infrastructure.

Shanghai Firm Completes Satellite Network

94P60236F Shanghai WEN HUI BAO in Chinese 4 Apr 94 p 1

[Article by Yao Shihuang [1202 6108 3552] and Qian Weihua [6929 4850 5478]: "'Space Highway Network' Installed at Shanghai Stock Exchange for Instantaneous Information Transmission Nationwide"]

[Summary] A 1.5-year-old Shanghai Caohejing New Technologies Development Zone high-tech firm called Shanghai Gaozhi [7559 2535] S&T Development Co and its partner firm, Shanghai Xinhua Computer & Electronic Information Co, have developed, designed, installed, and put on-line a satellite digital transmission network—the "Space Highway Network" or "Information Bridge"—for the Shanghai Stock Exchange (SSE). This network provides instantaneous (0.5 s) synchronous transmission of stock and economic information from the SSE to over 1000 small satellite earth stations nationwide, many of them hundreds and thousands of km distant from the SSE. The network has also been successfully used for newspaper fax transmission: in only 20 minutes, the network system can provide errorless transmission of an 8-page issue of WEN HUI BAO to nine regional printing plants nationwide. This service has been in operation for 6 months without any errors. The satellite used to relay these services is located at an altitude of 36,000 km.

CAS Forms Policy/Research Expert Group

94P60236G Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 13 Apr 94 p 3

[Article by You Daban [6755 1129 6586]: "'High-Speed Information Network Policy and Research' Expert Group Formed"]

[Summary] To accelerate the pace of economic and social information modernization, the Chinese Academy of Sciences (CAS) Bureau of Technological Science the other day formally established an inter-agency, inter-industry expert group for "Policy/Research on Developing Domestic High-Speed Information Networks." CAS assigned as group director Prof. Ye Peida, noted Beijing P&T University communications specialist and a CAS Academician. As expert group vice-director, CAS named Prof. Chen Junliang [7115 0193 0081]

SIC Official Urges State, Industry to Build Infrastructure

94P60236H Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 16 Apr 94 p 1

[Article by Wu Jiapei [3527 1367 1014], State Information Center (SIC) Vice-Director (and participant in aforementioned KEJI RIBAO Symposium): "Some Reflections on the Global Information Infrastructure Tide"]

[Summary] China has had enough of the bitter taste of a backward information infrastructure. If the nation does not now work out such an infrastructure, then by the next century—even though the old "bottleneck" restrictions may be resolved—a new "bottleneck" will appear: the added difficulty of [jointly] raising industrial competitiveness and the State's comprehensive national power. China's present level in information technology is 30-40 years behind that of the U.S. To raise industrial competitiveness and the State's overall national power, China must firmly take up the task of building an information infrastructure suited to domestic conditions, incorporating innovative technologies and management practices, documented by relevant laws and standards, and based on research and surveys into the economic and social benefits of this global tide. So far, China's information infrastructure building has been government-driven, unlike the market-driven form seen in the U.S. This situation needs to be changed: non-government investment must be encouraged, industrial activity and the entrepreneurial spirit must be part of the overall campaign; industry leaders must no longer rely on the government alone before taking action. In the area of resource allocation, the government has invested over 20 billion yuan, which went for construction of a dozen-odd major information systems, and is investing an additional 50 billion yuan for construction of information systems at as many as 10,000 firms.

Shanghai-Nanjing DS5 Fiber Optic Cable Completed

94P60236I Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 18 Apr 94 p 1

[Article by Li Mingqi [2621 2494 0796]: "Shanghai-Nanjing High-Speed, High-Capacity Fiber Optic Cable Communications Project Completed"]

[Summary] The Shanghai-to-Nanjing 565 Mbps [i.e. DS5] fiber optic cable communications project has been completed. This optical cable project, jointly undertaken by MPT's Design Institute, the Wuhan Institute of P&T Science, and the China Communications Construction Corporation, was based on an extension of the Shanghai-Wuxi DS5 cable, which passed acceptance check a while back. The Shanghai-Nanjing cable, almost 400 km in total length, has a main channel capacity of 15,360 voice circuits, with 720 voice circuits for inter-district communications.

Huaxun Corp Director Urges Unified State Plan

94P60236J Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 21 Apr 94 p 1

[Article by Dai Huanzhong [2071 3562 1813], Governor, Beijing Huaxun [5478 6061] Communications Development Corp (and participant in the aforementioned KEJI RIBAO Symposium): "A Development Leap Appropriate to National Conditions"]

[Excerpt] [Passage omitted] Our hopes [from the issues discussed at the KEJI RIBAO Symposium] are as follows: first, the State needs to devote a higher degree of its attention and resources to building an information infrastructure and to prepare in advance for public opinion—the arguments in this area are not yet sufficiently clear; second, we urge the State Planning Commission, the SSTC, and other authorities from now on to stress planning, organize expert groups in relevant disciplines, and conduct some early experiments. Finally, for the present moment, if there is to be [effective] market competition, the State should adopt a unified plan to establish a work sequence that in orderly fashion is introduced into the market mechanisms.

U.S. Businessman Praises Plan

OW2804221394 Beijing XINHUA in English 1415 GMT 28 Apr 94

[Text] Beijing, 28 Apr (XINHUA)—A U.S. expert on data networking today described China's "Golden Bridge" project to build up an information superhighway as a powerful tool for promoting administrative efficiency, fostering improved communications and coordination between the government, companies and people of the whole country.

At a seminar on building information superhighways for the next century, Eric Benhamou, President of the U.S. 3Com Corporation, delivered a keynote speech to Chinese officials and engineers drawn from relevant ministries and research institutes. "A Golden Bridge that spans both government and private sector will elevate China to a major economic player on the world stage," said Benhamou, who is concurrently Chairman of the American Electronics Association's National Information Infrastructure (NII) task force. He added that as information increasingly becomes the currency of international trade, the Golden Bridge will enable China to tap into global information flows, further integrating China into the global economy.

Benhamou believes that by using the Golden Bridge to provide database access and facilitating electronic data interchange, China's society will rapidly enter the information age. It can also inform and educate by liberating resources and bring health care and scientific, commercial, and financial data to the individual. He suggested that China should choose the best scheme in constructing an information project, so as to avert the

setbacks that have been experienced by Western countries. At the same time, China should rationally balance the rules for informational market competition—allow competition while maintaining macro control. He revealed that the 3Com Corporation will shortly set up a representative office in Beijing, in a bid to help develop a pool of networking expertise in China.

China to Build Information Superhighway

OW0505161294 Beijing XINHUA in English 1446 GMT 5 May 94

[Text] Beijing, 5 May (XINHUA)—China has mapped out an ambitious plan to build its own information superhighway with a focus on an information application system, a nationwide public data service network and an advanced telecommunications network. In a recent symposium on the wide use of information in the national economy and China's information superhighway, Minister of Posts & Telecommunications Wu Jichuan said China will watch closely the world's latest developments in information superhighway construction and carry out its own in a planned and step-by-step manner. He said China will expand the application of computers in digital [telephone] exchanges, accelerate the construction of optical fibers and build an internet by developing a network telecommunications platform based on the country's public telecommunications network.

The symposium, attended by China's senior officials and information experts, exchanged information on the world's current trend of information superhighway construction, its definition and its social economic significance. China's demands for such a highway and its potential were widely discussed at the symposium, the first of its kind in China.

As part of the effort to cope with the world's new information revolution, China is busy building 22 national-level optical fiber trunk lines to connect all the provincial capitals, 20 digital microwave trunk lines, and large and medium-sized satellite telecommunications ground stations. According to government sources, the high-capacity digital transmission network connecting the country's major provincial capitals will be completed early next year. First-phase construction of a nationwide digital switching network was completed last September. At present, the network extends to 267 of China's major cities and has started to exchange information with 37 centers in 20 countries and regions. Meanwhile, the first-phase project of the high-speed digital trunk line connecting 21 provinces and municipalities will be put into operation this July. A cellular phone network has covered the coastal provinces in the Southeast and some central provinces.

Viewing the current level of information modernization, experts said that the 700,000 mobile telephones will be linked by a nationwide network soon. China's 7 million radio pagers have made the country one of the world's largest paging markets. Computers have been widely used in banking, customs clearance, railway transportation, civil aviation and weather forecasting. These, in all, will contribute to China's information modernization, experts commented.

As another major step in the construction of the information superhighway, China plans to accelerate high-tech research concerned with information modernization, especially advanced remote sensing, surveying, computers, automation facilities and modern telecommunications technologies.

The construction of the information superhighway is a systematic project which will involve different fields of work, said Minister Wu Jichuan. He called on the joint efforts of participating departments to work toward erecting the modern information network.

Minister Discusses Ninth FYP for Telecommunications

OW1205191294 Beijing XINHUA in English 1632 GMT 12 May 94

[Text] Beijing, 12 May (XINHUA)—By the end of this century, China will finish construction of a major telecommunications network composed of 16 optical cable trunk lines, which will cover all the provincial capitals and become connected with the world's network. Minister of Posts & Telecommunications Wu Jichuan said today that the Ninth 5-Year Plan (1996-2000) for telecommunications development has been initially drafted. He said that in the new plan priority is given to construction of long-distance optical cable networks.

According to major targets set in the plan, the ministry's total business volume will have an annual average growth rate of 23.7 percent, while the annual average growth rate for its business income will be 24.2 percent. Wu said that fulfillment of the plan will bring the national telephone capacity from the present 42 million lines up to 140 million lines, and the national telephone availability rate will reach 8 percent, while that for urban areas will reach 30-40 percent. In addition, mobile telephones will cover all the country's large and medium-sized cities, as well as most of the towns, basically realizing national automatic roaming.

The ministry will establish its own air postal routes and improve other postal facilities to shorten mail delivery time. Meanwhile, computer networks will be established for EMS [electronic mail system] inquiries, issuing of publications, postal management, postal deposit and other business.

Posts and telecommunications have been experiencing the fastest development among all the country's industries in the past few years. Last year its growth rate reached 59 percent, exceeding the development speed of the national economy for the ninth successive year. An official from the ministry predicted that this year the sector will maintain a development speed of about 50 percent.

To ensure that the targets set in the plan be fulfilled, the ministry has drafted a huge budget of 360 billion yuan for the construction of posts and telecommunications infrastructures. At present, China's telecommunications capacity ranks seventh in the world; if all these targets are met, it will be able to edge into the world's first three positions.

Motorola Homing In on Pager Market

40100063A Beijing CHINA DAILY in English 5 May 94 p 2

[Article by Wang Yong: "Motorola Homing In on Beeper Market"]

[Text] The U.S. telecommunications giant Motorola is to increase its production of beepers in China in order to tap the potential of the local market. "We will expand production by at least 50 percent this year," said K.Y. Chan, sales director of Motorola's North Asia Paging Products Group.

There is plenty of room for expansion in China. This is because there are 400 million city dwellers in the country but only 10 million pagers. In developed countries, on the other hand, 12 out of 100 people have pagers.

In 1992, Motorola invested more than $100 million into its manufacturing base in Tianjin City, North China. And so far, the plant has churned out more than 1 million beepers priced at 1000 yuan ($115) each.

"There are about 3 million Motorola pagers in use in China at present, if imports from Singapore are included," Chan said. Singapore is the leading manufacturing base of Motorola in the Asia-Pacific region, providing nearly all the pagers which display information with Chinese characters. But towards the end of the year the Tianjin base will also start producing pagers with Chinese characters, said Chan. He did not say how many such pagers will be produced per year in the future.

Motorola's biggest potential rivals in China include Japan's NEC and some Chinese manufacturers from Guangdong Province in the South. The American company has captured a third of the Chinese pager market. And the multinational firm has also cornered more than half of the global market which requires 15 million beepers a year.

"Motorola's top three markets are the U.S., Japan and China, and we are anticipating a bigger local production in China," said Chan.

Motorola staged a sales promotion campaign in Beijing recently, selling more than 23,000 pagers.

Statistics show that the number of China's pagers increased by 152 percent in 1993 over the previous year. And the country's telecommunications market has grown rapidly, said Liu Cai, head of the policy department of the Ministry of Posts & Telecommunications. But he admitted that telephone systems, particularly mobile [phones] and beepers, are still in their infancy in China. By the year 2000, China will have more than 5 million mobile phones, he said.

And the number of pagers is expected to boom during the same period. Pagers will become one of the most sought-after consumer goods in the 1990s, an official said.

IBM to Invest in Data Network

40100063B Beijing CHINA DAILY in English 4 May 94 p 2

[Article by Pei Jianfeng: "IBM to Invest in Data Network"]

[Text] International Business Machines (IBM) will invest at least $100 million in information technology projects in China, the U.S. computer giant announced yesterday in Beijing. This will include being the first foreign company to be involved in the country's top information infrastructure project. "It is a major step in relations between IBM and China and will be beneficial to both sides," said IBM Vice-President Robert M. Stephenson.

The deals come under a memorandum of understanding signed last Thursday in the U.S. between Big Blue and the Ministry of Electronics Industry during Chinese Vice-Premier Zou Jiahua's visit.

The first project will set up a joint venture in Beijing with Jitong Communications Company, which oversees the Three Golden Projects, China's information infrastructure plan. The massive project aims to set up economic information networks across the country covering banking, customs and inter-governmental exchanges. The joint venture will produce networking technologies to support the plan.

In the first phase, it will help design and install regional communications networks and link them into a national system, said Robert M. Savage, Chairman of IBM China Company Ltd. He said IBM will pump several million dollars into the venture, which will be finalized in 6 weeks. More importantly, the company will bring in experts from its system integration divisions in the U.S. and Europe, he said.

IBM has been named as consultant to the project as well as other technology proposals by the Ministry of Electronics Industry. Under the memorandum of understanding, IBM will establish a wholly-owned software development centre in Shanghai to develop system and application programmes for the domestic and foreign markets, Stephenson said. It will also set up three open system networking centres in Beijing, Shanghai and Guangzhou.

In return, China pledged to use IBM's PowerPC platform as one of the major microprocessors in planning the country's future. PowerPC, a chip jointly developed by

IBM, Apple and Motorola, seeks to break Intel's world monopoly on the computer.

AT&T Inks Two Deals to Supply Equipment

40100065A Beijing CHINA DAILY in English 9 May 94 p 2

[Article by Liu Weiling: "AT&T Inks Two Deals to Supply Equipment"]

[Text] American Telephone and Telegraph (AT&T) signed two contracts over the weekend to supply the most modern transmission and network management equipment to the Beijing Telecommunications Administration (BTA). The deals, totaling more than $20 million, will give the city the largest and most sophisticated digital transmission network in China. It will also result in the city having the most advanced network management capabilities for the surveillance and control of its entire public telecommunications network.

The sale represents the first time AT&T will supply high-speed transmission equipment to China since the demise of the Co-ordinating Committee on Multilateral Export Control [COCOM]. The 17-member organization controlled technology transfer to the East Bloc for 44 years and ceased to exist on April 1.

Under these contracts, AT&T will supply BTA with two state-of-the-art systems: SDH (Synchronous Digital Hierarchy) fibre optic transmission equipment operating at 2.488 Gb/s (gigabits per second) and a set of advanced network management and surveillance systems to monitor and manage the communications network.

With the equipment, Beijing will be able to offer advanced telecommunications services and have the flexibility to move forward with new services, according to BTA officials. Zhang Ligui, Director General of BTA, said the signing of the two AT&T/BTA agreements signifies that cooperation between AT&T and Beijing has entered a new stage.

William Warwick, Chairman of AT&T China Incorporated, said, "We see these projects as an important milestone in building our relationship with the BTA. This is our first delivery of SDH technology to China since President Clinton lifted export controls on high-speed transmission sales," Warwick added.

AT&T currently has nine joint ventures in China.

AT&T Inks $150 Million Deal With State

40100060A Beijing CHINA DAILY in English 30 Apr 94 p 2

[Article by Liu Weiling]

[Text] AT&T signed a series of agreements yesterday that guarantee the US communication giant will invest $150 million and triple its 800-strong staff in China over the next two years.

Under the deals with the State Planning Commission, AT&T will provide technology, products and services to China.

Last year the two sides signed a memorandum of understanding to set up a long-term partnership.

Ceremony in U.S.

Yesterday's agreements, signed in the U.S., called for AT&T to establish:

—Two joint ventures capable of producing 2 million switching lines per year for China, with factories located in Chengdu, Sichuan Province and Qingdao, Shandong;

—A microelectronics joint venture to design and produce integrated circuits known as VLSI (Very Large Scale Integration); the location will be decided this summer;

—An AT&T Bell research and development facility;

—Training courses for mid-level and senior Chinese managers in planning, communications, electronics and other industries;

—And a comprehensive network management programme with the Ministry of Posts and Telecommunications that will handle the sale and development of hardware and software systems for network surveillance, management and control.

The programme should alleviate problems in China's vast telecommunications system.

"AT&T is committed to providing China with digital and fibre-optic technologies that are the latest and best in the world so it can leapfrog almost overnight into the information age," said William Warwick, chairman of AT&T China.

The company yesterday also agreed to explore remaining areas of co-operation outlined in last year's memorandum.

Since the signing in February 1993, AT&T has secured more than $500 million in sales contracts and last year doubled its 1992 revenues in China.

The company has already set up nine joint ventures in the country; they are engaged in marketing wireless systems, international long-distance services, computer products and networks.

Nation's Second High-Capacity Fiber Optic Cable Operational by End of 1994

94P60252A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 4 Apr 94 p 1

[Article by Zhu Fuchang [2612 4395 2490]: "Nation's Second High-Capacity Fiber Optic Communications Cable Operational by Year's End"]

[Summary] Following upon last year's completion of the nation's first high-capacity fiber optic communications cable—the Beijing-Wuhan-Guangzhou overhead 12-fiber optical cable—China this year will build its second high-capacity cable: a buried multi-fiber cable linking these same three cities and scheduled for completion by year's end. This project, which uses new-generation domestically made digital fiber optic communications equipment developed by MPT's Wuhan Institute of P&T Science, will employ the 1B1H encoding format suited to China's needs. The project employs a number of advanced technologies, including VLSI circuits and thick-film circuits, integrated digital signal processing/computer techniques, and miniaturized, low-loss, high-reliability equipment. Each system, in addition to the 1920 circuits provided in the main channel, can furnish an additional 1200 circuits (an increase of 62.5 percent capacity) via application of the "H" code. The Beijing-Wuhan-Guangzhou buried optical cable project, funded by a loan from the Asian Development Bank, employed international tenders. After sharp competition, the contract was awarded to MPT's Meishan Communications Equipment Plant.

End-Office Digital SPC Switch Developed

94P60252B Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 7 Apr 94 p 1

[Article by Liu Yuan [0491 1254]: "End-Office-Use Digital Stored-Program-Controlled Switch Developed"]

[Summary] The first group of ZXJ2000 end-office-use digital stored-program-controlled (SPC) switches, recently developed by Shenzhen Zhongxing [0022 5281] New Communications Equipment Ltd., have just been granted a certificate by MPT for installation at telephone end offices and for connection with existing networks. Annual production capacity for this new domestically made switch is 1 million lines, and total installed capacity is 450,000 lines; this would permit capture of one-fifth of the nation's rural telephone market and would make this model the largest selling independently developed and domestically manufactured digital SPC switch in terms of installed capacity.

National Developments

Energy Production, January 1994

94P60213 Beijing ZHONGGUO NENGYUAN [ENERGY OF CHINA] in Chinese No 3, 25 Mar 94 p 19

[Text]

Energy Production, January 1994

	Unit	January		Jan Cumulative percentage of increase over same period of 1993
		Cumulative	Current worth	
Total energy output	10,000 tons standard coal	8365	8365	23.4
Raw coal	"	8616	8616	27.3
Unified distribution mines	"	3946	3946	18.6
Local small, medium mines	"	4670	4670	35.7
Clean coking coal	"	543	543	19.5
Coke (machine coke)	"	486.95	486.95	5.0
Crude oil	"	1326.14	1326.14	8.6
Processed crude	"	1096.6	1096.6	4.0
Gasoline	"	231.57	231.57	-7.6
Kerosene	"	34.4	34.4	7.5
Diesel	"	259.84	259.84	-0.4
Lubricating oil	"	16.1	16.1	-6.2
Heavy oil	"	256.39	256.39	-2.4
Natural gas	100 million m^3	14.85	14.85	70.7
Electric power	100 million kWh	722.93	722.93	16.8
Hydropower	"	96.74	96.74	39.2
Thermal power	"	620.56	620.56	13.1

Source: State Statistical Bureau

Northwest Hydro, Thermal Power Development Entering Stage of Major Growth

946B0014B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 19 Oct 93 p 2

[Article by reporter Su Minsheng [5685 3046 3932]: "Electric Power in Northwest China Enters Period of Major Development, More Investments in 1993 To Accelerate Construction of More Than 10 Key State Hydropower and Thermal Power Projects"]

[Text] After the northwest China region placed 1,750MW of installed electric power generating capacity into operation in 1992, it also invested in 1993 to speed up construction of more than 10 key state hydropower and thermal power projects, which is an indication that northwest China's electric power industry has entered a period of major development.

A large electric power construction army numbering tens of thousands in Shaanxi, Gansu, Ningxia, Qinghai, and Xinjiang now has the attitude of a decisive battle and is fighting in the barren and dangerous valleys in the upper reaches of the Huang He, the "Black Belt" of Guanzhong [central Shaanxi plain], and other construction sites as an unceasing high tide of construction appears in each project. At the large Lijia Gorge hydropower station, where they plan to install the four biggest Chinese-made generators with unit capacities of 400MW, after impounding the river and completing excavation of the foundation for the key facility and making progress with other important construction tasks, they entered the key construction phase for pouring the concrete for the 165-meter-tall dam and main plant buildings between April and July 1993. This 3,110MW power generation facility now under construction will go into operation and begin generating power at the end of 1993.

At the end of 1992, northwest China's installed generating capacity was 14,417MW and its annual power output was 60.093 billion kWh, with hydropower accounting for nearly one-half of this amount.

Development of its hydropower resources is northwest China's first step in electric power construction. While

developing Ankang, Shiquan, Bikou, and other hydropower stations on the Han Jiang and Bailong Jiang, Shaanxi and Gansu have also joined with Qinghai and Ningxia to concentrate their superior forces in the main attack on one of China's biggest hydropower "motherlodes" on the upper reaches of the Huang He by completing five cascade hydropower stations represented by the two big hydropower stations at Longyang Gorge and Liujia Gorge and including Yanguo Gorge, Bapan Gorge, Qingtong Gorge with a total installed generating capacity of 3,268MW. Statistics show that between the time the first generator began generating electricity in 1961 and the end of September 1993, these five hydropower stations generated a total of 21.13 million kWh. The five large reservoirs associated with these power stations also irrigate more than 16 million mu of farmland along both banks of the river. Moreover, they have used their excellent regulation properties to basically resolve flooding, freezing, and other disasters along the banks of the middle and upper reaches of the Huang He, which has significantly improved the ecology and environment of the northwest China plateau. The area around the reservoirs, where not a blade of grass had grown for a long time, is now shaded by green trees.

According to the newest development program by the Northwest China Electric Power Industry Management Bureau and Northwest China Hydropower Survey and Design Academy that was revised in 1993, besides the six power stations already built or now under construction on the upper reaches of the Huang He, they have also decided to build seven large cascade hydropower stations at Gongbai Gorge, Laxiwa, and other locations and 12 medium-sized cascade hydropower stations at Da Gorge and other locations which can increase the total installed generating capacity to 15,740MW with annual power output of 57 billion kWh. Evidently, the timetable for the 19 new cascade hydropower stations to be built on the upper reaches of the Huang He has now been arranged and it is expected that they can all be developed by the early part of the next century.

Embodying the new idea of "changing from transporting coal to transmitting electricity," thermal power construction has accelerated the pace of construction of the new Pucheng power plant and other new construction and expansion projects in addition to speeding up preparatory work for construction of Baoji No. 2 power plant, Hancheng No. 2 power plant, and Shenmu, Huangling, and other large pit-mouth power plants.

According to information provided by officials in the Northwest China Electric Power Industry Management Bureau, after these electric power projects are gradually implemented, annual power output in the northwest China region will reach 69 billion kWh in 1995. At that time, besides satisfying the needs of industrial and agricultural production and the masses' lives in these five provinces and autonomous regions, these abundant power sources will also transmit power to east China, central China, southwest China, and other regions.

Local Power Development in Anhui Recapped

946B0014C Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 21 Oct 93 p 2

[Article by reporters Wang Zhengzhong [3769 2973 1813] and Zhang Houhai [1728 0624 3189]: "Anhui's Local Power Industry Is Growing by Leaps and Bounds"]

[Text] Anhui Province is raising capital at many levels and through many channels in a major effort to develop its local electric power industry and alleviate the entire province's electricity shortages.

To reduce its energy resource shortages, the Anhui Provincial Government has approved the establishment of the Anhui Province Electric Power Development Corporation to represent the interests of the local electric power industry, assume special responsibility for raising and managing capital for a provincial-level electric power construction fund (including the use of foreign investments) and for local energy resource project development and construction. By the end of September, 1993, the corporation had raised a total of 2 billion yuan in capital for power development. It has made independent investments to build five 125MW generators at Hefei, Tongling, Ma'anshan, and other cities and it is participating in joint investments to establish the key state construction projects at the Luohe and Pingyu power plants and the Huaibei and Wuhu power plants for six generators with a total capacity of 1,400MW. The corporation has also invested over 100 million yuan in joint investments to complete the Huaibei Tongting Coal Mine with an annual coal mining capacity of 450,000 tons.

Apparently, Anhui Province also recently decided to use the Anhui Province Electric Power Development Corporation to organize the "Anhui Energy Company, Ltd." to issue public stock to raise an enormous amount of capital to accelerate construction of its local electric power industry and increase Anhui's total installed generating capacity to 10,000MW by the year 2000.

Hydropower

Accelerating Hydropower Cascade Development in Southwest

946B0014A Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 18 Oct 93 p 2

[Article by reporters Long Wenbin [7893 2429 1755] and Zhao Wei: "Accelerating Hydropower Cascade Development, Establishing a Southern Electric Power Corridor, Hydropower Construction in Southwest Will Provide a Powerful Motive Force for Economic Takeoff on the Southeast Coast"]

[Text] Southwest China, crisscrossed by rivers, is the region of China with the most abundant hydropower resources. It has 194,000MW of developable hydropower,

equal to 51.7 percent of China's total hydropower. Currently, six of the 12 key cascade development base areas being built through State plans are located in southwest China's Jinsha Jiang, Yalong Jiang, Dadu He, Lancang Jiang, Wu Jiang, and Hongshui He river basins.

With major efforts by the State to provide support, energy resource development in southwest China, which has mainly involved hydropower, has entered the best period in the last decade. According to incomplete statistics, Yunnan, Guizhou, and Sichuan provinces and Guangxi Zhuang Autonomous Region invested 16 billion yuan in capital during the Seventh 5-Year Plan alone in electric power construction, more than four times greater than the total amount invested during the Sixth 5-Year Plan, adding 6,000MW in new generating capacity. As we enter the Eighth 5-Year Plan, the pace of construction has been further accelerated. During the past two years the primary grids completed 5.86 billion yuan in electric power construction investments and added 2,430MW in installed generating capacity. At the end of 1992, these three provinces and one autonomous region had a total installed electric power generating capacity of 20,155MW, including an installed hydropower generating capacity of 9,640MW. Sichuan Province, which has developed at a rapid pace, increased its total installed electric power generating capacity from 4,624MW in 1985 to 9,565MW in 1992, more than doubling it.

The deployment of energy resource development in the vast southwest China region is focused on cascade development of six large river basins. In plans for the trunks, 65 large and medium-sized hydropower stations have been designed with a total installed generating capacity scale of 120,000MW, including 11 that have been completed or are now under construction with a total installed generating capacity of 10,810MW and annual power output of 51.92 billion kWh. According to the Ninth 5-Year Plan, another seven large hydropower stations with a total installed generating capacity of almost 20,000MW will be built in succession. Electric power experts predict that by the end of this century, the installed hydropower generating capacity in southwest China will increase substantially and form China's biggest hydropower base area cluster in these six large basins.

As hydropower energy resource base area construction is developed, southwest China's electric power industry, which had been backward for a long time, has begun to enter the development phase of large power grids, large power plants, large generators, high voltages, and high automation levels. In the early 1980s, southwest China had only two large hydropower stations bigger than 500MW, but today we have now completed or are in the process of building five hydropower stations at Ertan, Manwan, Yantan, and Tianshengqiao First Cascade and Second Cascade, all of which have installed generating capacities greater than 1,200MW. This is particularly true of Ertan Power Station in Sichuan, which has a total installed generating capacity of 3,300MW and six generators that will generate 17 billion kWh of electricity annually, the most electricity generated among the hydropower projects under construction in China in these three indicators.

Since 1992, we have installed three 500 kV power transmission and transformation lines, the largest in China in terms of capacity, between Guiyang and Tianshengqiao, Manwan and Kunming, and Tianshengqiao and Foshan in Guangdong, which is an indication that a preliminary key electric power facility linking south China and southwest China has been completed.

Initial Preparations for Three Gorges Project Said Going Smoothly

946B0016B Beijing RENMIN RIBAO OVERSEAS EDITION in Chinese 30 Oct 93 p 1

[Article by Xinhua reporter Lu Yongjian [7773 3057 1696], trainee Yu Xiaokui [0151 2556 5525], and RENMIN RIBAO OVERSEAS EDITION reporter Xia Jun [1115 8823]: "Initial Preparations for Three Gorges Project Are Progressing Smoothly, Guo Shuyan [6753 2885 6056] and Others State at a Press Conference for Chinese and Foreign Reporters, Static Investment for the Entire Project Will Require About 95.4 Billion Yuan, Open Bidding To Requisition Land Being Speeded Up, Resettlement in Xinjiang and Tibet Is Purely a Rumor, International Cooperation Will Be Further Strengthened, Construction of the Project Will Benefit the Ecology and Environment, Construction Capital Being Raised Through a Variety of Channels"]

[Text] A press conference was held on 29 October 1993 in the News Office of the State Council. State Council Three Gorges Project Construction Commission Deputy Director Guo Shuyan stated at the meeting that all items of initial preparations for the Three Gorges key water conservancy facility have begun in 1993 and that all items of initial preparations work are progressing smoothly. The pace of resettlement from the dam area has been speeded up and resettlement program work in the reservoir area is now fully underway.

While answering reporters' questions concerning progress at the Three Gorges project, China Three Gorges Project Corporation General Manager Lu Youmei [7120 0147 2812] said that 1993 is the first year of preparation for construction and with an investment of 2 billion yuan, it will be completed. Preparations for open bidding for requisitioning of the land, construction of roads and bridges, engineering around the main project, and several other projects is now progressing smoothly. All of these will create the conditions for a comprehensive start of construction on the main aspects of the Three Gorges project.

Concerning the resettlement issue, Guo Shuyan and Three Gorges Project Construction Commission Resettlement and Development Bureau Director Tang Zhangjin [0781 4545 6930] refuted the rumor that China

will resettle people in Xinjiang, Tibet, and other frontier regions. Guo Shuyan said that recently several news media outlets in foreign countries had transmitted the news that China is already resettling people in Xinjiang, Tibet, and other places and that this is either a well-intentioned misinterpretation or a pure fabrication that is deliberately provocative. Tang Zhangjin said that after many years of trials and experiments, China has accumulated rich experience regarding resettlement in the Three Gorges region and that when the project is completed 1.13 million people will have to be moved, with arrangements for most of them being made locally.

Concerning the prospects for international cooperation in the Three Gorges project, Guo Shuyan said that as the Three Gorges project gradually unfolds, international cooperation will be further strengthened. In November, 1993, we will invite several international water turbine generator manufacturers to Wuhan to discuss their intentions concerning cooperation, and we will have broad-ranging contacts with international construction equipment and power transmission and transformation equipment manufacturing companies and promote the establishment of Chinese-foreign joint ventures. In the area of importing capital, China is now studying capital-raising measures for importing foreign buyers' credit and issuing stocks and bonds in China and foreign countries at the appropriate time. He said that China welcomes foreign enterprises and investment organizations to participate in construction of the Three Gorges project and the Three Gorges reservoir region.

While answering reporters' questions concerning the issue of environmental protection in the Three Gorges region, Guo Shuyan said that construction of the Three Gorges project will have a beneficial effect on the ecology and environment of the middle and lower reaches of the Chang Jiang, especially in substantially improving flood control standards and making the water clearer. What has aroused concern in China and foreign countries is the reservoir inundation and resettled population arrangements that result from the Three Gorges project and the negative impact these will have on the ecology and environment. These have already received a high degree of attention from the Chinese Government and it has formulated the corresponding measures. He said that on the new land used for production for the resettled population, we will organize the building of rather high-level terraced fields and develop production. To reduce soil erosion, the State is now implementing a shelter forest plan for the middle and upper reaches of the Chang Jiang. The government will also establish several animal and plant protection regions to protect the valuable animal and plant resources in this region. Since construction of the Gezhouba project, we have discovered that Chinese sturgeon have established a new spawning ground below the dam and that the related areas are providing additional protection and doing a great deal of artificial breeding and releasing.

A reporter asked whether or not the investment in the Three Gorges project would be a factor that in causing inflation. For 1993, investment in the Three Gorges project is 2 billion yuan and the average investment each year after construction of the project formally gets underway will be about 5 billion yuan. While this is a large figure, compared to China's total investments in fixed assets of more than 1 trillion yuan each year, it will only account for about 0.5 percent, so it will not have a significant impact or become a factor in further inflation.

Additional report: According to information provided by State Council Three Gorges Project Construction Commission Deputy Director Guo Shuyan, based on April 1993 price levels, the static investment in the entire Three Gorges project will require about 95.4 billion yuan renminbi. Based on policies already promulgated by the Chinese Government, the state will set aside 0.003 yuan per kWh of electricity in China, which can raise an average of 1.5 billion to 2.0 billion yuan renminbi per year. Moreover, the Gezhouba Power Station has been turned over to the China Chang Jiang Three Gorges Project Development Corporation and all the net income from the power it generates will be used for the Three Gorges project. These two funding items will provide a total of about 32.7 billion yuan renminbi over 11 years, equal to 62 percent of the required investment in the Three Gorges project over the same period.

Big Pumped-Storage Station To Use Imported Machinery

946B0017A Beijing RENMIN RIBAO in Chinese 16 Oct 93 p 1

[Article by reporter Zhang Yijun [1728 4135 0193]: "Tianhuangping Power Station To Import Primary Equipment, Li Peng Attends Signing Ceremony and Meets With Chinese and Foreign Manufacturers"]

[Text] Contracts for importing the primary equipment for Tianhuangping pumped-storage power station, a World Bank loan project for which the China Technology International Bidding Company has purchasing responsibility, were signed on 15 October 1993 in Beijing. State Council Premier Li Peng and others attended the signing ceremony and met with representatives of the Chinese and foreign manufacturers involved in the cooperation.

Li Peng said that the development of electric power in China is now facing two problems. One is a power shortage, and the other is a less than rational structure of hydropower and thermal power, especially the shortage of hydropower regulation in economically developed regions. There are still great development prospects for pumped-storage power stations in China.

Tianhuangping pumped-storage power station, located in Anji County, Zhejiang, is China's third large pumped-storage power station following the Guangzhou pumped-storage power station and the Shisanling pumped-storage power station. Its reversible mixed-flow pumped-storage generators with a total capacity of 1,800MW

make it the largest scale and highest head pumped-storage power station in China at the present time.

The primary equipment for Tianhuangping pumped-storage power station is being purchased through international competitive bidding arrangements through the China Technology International Bidding Company under the China Technology Import/Export Corporation. A manufacturing group composed of companies from Norway, Canada, and Austria won the bidding.

Evidently, construction of the power station project will be completed in the year 2000. After going into operation, its primary responsibility will be to perform peak regulation, frequency regulation, phase regulation, accident reserve, and other roles in the East China Power Grid. Its completion will play a major role in improving the power supply situation in the east China region and spurring economic development in the region.

Ertan: Centerpiece of Southwest Hydropower Development Plan

946B0021 Beijing RENMIN RIBAO in Chinese
14 Oct 93 pp 1-2

[Excerpts from article by RENMIN RIBAO reporters Xie Guoming [6200 0948 2494] and Liao Yu [1675 ?] and ZHONGGUO DIANLI BAO reporter Wang Yucai [3769 3768 2088]: "Lighting Up Southwest China—A Report from Ertan"]

[Text]

I. The First Step in Opening the Hydropower Treasurehouse of Southwest China

The developable and usable hydropower resources of Sichuan, Yunnan, and Guizhou provinces account for more than one-half of our national total, but the development and utilization rate at present is only 3.4 percent, less than one-half our national average.

These two "one-halves" have formed a powerful discrepancy: a hydropower resource kingdom has serious power shortages! Sichuan, called the "province of 1,000 rivers," has a power shortage that has resulted in over one-third of the province's production capacity lying idle, reducing the industrial value of output by more than 100 million yuan a day. It has no guaranteed supplies of electricity for residents' household use and nighttime lighting.

On the one hand, there is a serious power shortage, while on the other hand, hydropower resources are flowing away unused.

According to the present program, southwest China's Jinsha Jiang, Yalong Jiang, Dadu He, Lancang Jiang, Nu Jiang, and Wu Jiang have 29 large hydropower station sites with a developable installed generating capacity of more than 200MW, 31 extra-large hydropower station sites with more than 1,000MW, 14 enormous hydropower station sites with more than 3,000MW, and two gigantic hydropower station sites with more than 10,000MW. This is a total installed generating capacity of 161,500MW that could generate 807.14 billion kWh of electricity a year.

Construction of Ertan Hydropower Station is the first step in comprehensively opening up the hydropower resource treasurehouse of southwest China. Its design installed generating capacity is 3,300MW with unit generator installed generating capacities of 550MW and annual power output of 17 billion kWh. These three project indices all rank first in China's power stations now under construction and it is China's first huge hydropower station with an installed generating capacity greater than 3,000MW.

The Ertan project has a huge scale, and it poses substantial technical challenges.

The power station will have a 240-meter-tall spillway-type dual-arch dam that can conserve concrete and reduce the amount of engineering. It is the first large dam in China taller than 200 meters and the third tallest in the world among this type of dam. The maximum thickness of the dam is just 56 meters and its minimum thickness is 11 meters. Compared to the 5.8 billion cubic meters of water its reservoir will impound, this large dam is so thin as to resemble an eggshell.

Because of the deep mountain gorges, the plant building of the Ertan hydropower station will be entirely underground. The underground plant building will be 280 meters long and 64 meters tall, as tall as a 25-story building. Its scale will rank first among China's hydropower stations and it will rank fourth among the world's underground plant buildings in terms of its scale of installed generating capacity.

The 17.5-meter-wide and 23-meter-tall diversion tunnel excavated to ensure that the flow is impounded for the weir for the pouring of the dam is as high as an eight-story building and is the world's biggest diversion tunnel. During an inspection, General Secretary Jiang Zemin called this diversion tunnel a "tunnel to win credit."

Ertan hydropower station is now creating several hydropower engineering "mosts" in China and in the world and it is a project of milestone significance in the history of hydropower construction in China.

II. The Hope and Tribute of Generations of People

The powerful electric energy from Ertan must penetrate the large and small frozen mountains at high elevations before it can be transmitted to the industrial center at Chengdu. To select a safe, reliable, and convenient power transmission line, 19 scientific research personnel and employees in the Southwest China Electric Power Design Academy led by senior engineers Zhang Zhineng [1728 1807 5174] and Li Baqun [2621 6405 5028] arrived at Huangyageng mountain pass at an elevation of 2,840 meters in Sichuan Province's Leibo County where

they built a 23-meter-tall tower and installed the conducting lines to observe the ice and snow freezing conditions on the conducting lines at different heights. They also built nine ice observation points along the 200 kilometer course. Each year in late November before the ice and snow sealed off the mountains, they climbed these, the world's highest man-made ice observation stations, and began their work, staying until the last part of March when the ice and snow began melting before coming down from the mountains. To date, this scientific research staff has spent 11 spring seasons in their simple home on the icy and snow-covered mountain and obtained a series of observational data that no one before them had obtained.

[passage omitted]

III. A New Attempt To Accelerate Development of Hydropower Resources

Developing and building hydropower stations on the lower reaches of the Yalong Jiang can provide extremely large amounts of electric energy and only requires that a small amount of land be flooded for the reservoir. The amount of land flooded per kW is just one-twelfth the average amount for the hydropower stations under construction in China as a whole. It also requires a small amount of engineering, with only one-half as much concrete being poured per kW as the average amount in the large hydropower stations now under construction in China. Added to the fact that this hydropower station is located near a large industrial center and is itself in the middle of the Pan-Xi (Panzhihua-Xichang) Development Zone, its development conditions are superior.

Why have these hydropower resources with such superior conditions not been developed and utilized for such a long time? The answer is simple: no money!

Since reform and opening up, a new opportunity has been created for developing southwest China's hydropower resources.

The World Bank saw the major social and economic benefits that would be derived from construction of the Ertan hydropower station and made an exceptional decision to loan $766 million. This is the biggest loan allocated for a single project since the World Bank was established.

Leading comrades in the State Council decided to use Ertan as a breakthrough point in taking a new route in development and utilization of hydropower resources. For this reason, the State Planning Commission gave special approval for the establishment of the independent planning Ertan Hydropower Development Company to serve as the proprietor for the Ertan hydropower station and assume full responsibility for rolling development of Ertan and the Yalong Jiang's hydropower resources.

The Ertan model of having the responsibility of a proprietor, raising capital from many areas, soliciting bids for the project, supervising and managing the project, and implementing rolling development of the river basin's hydropower resources is now gradually revealing its advantages.

As the proprietor, Ertan Hydropower Development Company must be responsible for raising the capital and for operating, managing, and repaying the principal and interest for the power station. Thus, during project construction it must make careful calculations and try to conserve. In the diversion tunnel project alone it has conserved over 30 million yuan in expenditures.

Because the entire project is assigned to a project supervision and management unit outside the proprietor and businesses with contractual responsibility, involving supervision and management by the Ertan Project Consulting Company, the Ertan Hydropower Development Company with just 100-plus people can also be involved in feasibility research and even initial preparations for other hydropower projects on the Yalong Jiang. Preparatory work has now been completed for Tongzilin Hydropower Station located more than 20 kilometers downstream from Ertan which will have an installed generating capacity of 400MW and the conditions are now ready for a formal start of construction. After the phased project at the Ertan hydropower station is completed, its machinery, equipment, and personnel can be transferred locally to build the Tongzilin hydropower station. The amount of time for initial preparations for it were shortened by more than two-thirds compared to conventional cases.

After Ertan Hydropower Station is fully completed in 2000, its annual income of more than 2 billion yuan from electricity sales will provide adequate financial support for rolling development of the Yalong Jiang's hydropower resources. Within 30 years, the Ertan Hydropower Development Company will complete five huge cascade hydropower stations with a total installed generating capacity of 11,100MW on the lower reaches of the Yalong Jiang whose annual power output could reach 68.9 billion kWh. It will be able to pay the State several 10 billion yuan in profits and taxes and accumulate over 100 billion yuan in property for itself.

The debate over whether construction of large hydropower stations means losses that outweigh the gains of high efficiency and low consumption has continued for more than 30 years. The successful development of Ertan will put an end to this debate.

IV. Chinese People Must Do Chinese Things Well

Ertan has imported a huge foreign investment and will implement comprehensive international solicitation of bids as required by the World Bank.

The result of the bidding is that huge hydropower engineering businesses in foreign countries have fought over the contractual rights for construction of the entire Ertan project. However, the foreign businesses with contractual responsibility have only sent some project

management personnel and technical experts, so the primary force in its construction will still be us, the Chinese.

The foreign businesses with contractual responsibility will use their enormous financial strengths and experience in building huge hydropower projects, so once they begin they basically will not see our hydropower construction staff.

Employees of China's Eighth Hydropower Bureau do not believe this. They have boldly stood up and proposed that they be given independent contractual responsibility for one of the projects to display our strengths!

The foreign businesses with contractual responsibility have seized the opportunity to get rid of a difficult task—the project to excavate the slope for the shoulder of the dam on the right bank. The inclination of this slope is 40 to 50 degrees and even wild mountain goats would have considerable difficulty in climbing it. Its construction will be very difficult, as one can imagine.

The Eighth Hydropower Bureau has accepted the challenge. They have organized the employees at Ertan that were dismissed by the foreign businesses and established a right bank construction team. Based on observation and analysis of more than a year of cooperation, the construction team has effectively integrated the project method construction management model of the foreign businesses with their traditional ideological and political work advantages and technical intentions to create a construction management arrangement with Chinese characteristics.

Focusing on the qualities of the employees, the Eighth Bureau has clearly pointed out that Ertan is a key State project for which the State has raised the construction capital. We are not working for foreigners but are instead contributing our youth and our skills for our own motherland, which has motivated the sense of having the responsibility of masters and the initiative of the employees. The construction team has brought in competitive mechanisms and abandoned mechanisms, and the construction team director has the complete authority required to manage the construction from transferring machinery to rewarding and punishing personnel, which has in turn increased work efficiency. What has astonished the foreign management personnel is that not only did the Eighth Bureau's right bank construction team complete its tasks on schedule, it also created the best benefits at Ertan of a per capita annual value of output of 110,000 yuan, which is 3.3 times the per capita average annual value of output in the Eighth Bureau as a whole. Even more important is that the right bank construction team eliminated the atmosphere of contention between management personnel and employees at the construction site and created a harmonious construction environment that stimulated the initiative and creativity of the construction personnel.

The facts have convinced the foreign businesses with contractual responsibility.

One of the businesses with contractual responsibility for the Ertan project, Italy's (Impregilo) Company asked the proprietor, Ertan Hydropower Development Company, and even the Ministry of Electric Power Industry to employ the Eighth Hydropower Bureau's construction staff at the construction site. The (Impregilo) Company's deputy chief arbiter (Tuomei) even announced that in the management levels of the Ertan joint venture, he wanted to "use Chinese to replace foreigners." In the end, they still rely on Chinese to do Chinese things.

We can import foreign investments and imported advanced management models and technical equipment, but we cannot import modernization.

We must still rely on ourselves to develop China's hydropower resources and light up the southwest.

Geheyan Update

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[Article by reporter Gong Dafa [7895 6671 4099]: "Geheyan Hydropower Station Construction Proceeding Quickly; Two Generators Placed Into Operation Within One Year"]

[Text] At 2045 hours on 2 December 1993 the No. 2 generator at Geheyan Hydropower Station on the Qing Jiang smoothly passed 72 hours of trial operation and was formally placed into operation to generate power, creating a good level of placing two generators into operation in one year in China's construction of 1,000MW-grade large hydropower stations over the same period.

Geheyan Hydropower Station will be composed of four 300MW generators. Installation of the No. 2 generator began on 5 April 1993, and assembly of the entire generator and static debugging were completed on 19 November 1993. The trial operation was successful on the first attempt and its maximum load reached 300MW. During the process of installing the No. 2 generator, the engineering and technical personnel created another new record in China's large water turbine generator installation and debugging: they took just 38 days to install the rotor of the No. 2 generator, 53 days less than No. 1. They took just nine days from full water debugging to the first connection to the grid, one day faster than the No. 1 generator which attained an advanced international level. After the No. 1 generator was placed into operation and began generating power ahead of schedule on 4 June 1993, they took only one-half year for the No. 2 generator to begin generating power ahead of schedule, which was 6 months and 29 days ahead of the original design power generation construction schedule.

Plan for Developing Hydropower Resources of the Northeast in the 1990s

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[Article by Zhang Tao [1728 3447] of the Northeast China Electric Power Industry Management Bureau]

[Text] While the Northeast China Grid's installed hydropower generating capacity only comprises 16.7 percent of the grid's total capacity, its peak regulation, frequency regulation, phase regulation, and load and accident reserve roles have significantly improved the quality of power supplies and ensured safe operation of the grid, and provided the grid with inexpensive power that has alleviated fuel shortages. Moreover, hydropower also has significant flood control, water supply, irrigation, and other comprehensive economic benefits. However, for a variety of reasons the pace of hydropower development in the northeast China region has been slow and it is not playing a greater role.

I. The Current Situation and Main Problems Facing the Northeast China Grid

A. The Current Situation in the Northeast China Grid

The Northeast China Grid covers the three provinces of Liaoning, Jilin, and Heilongjiang, as well as three leagues and one city in the eastern part of Inner Mongolia Autonomous Region. At the end of 1991, the grid had an installed generating capacity of 23,410MW, of which 3,920MW or 16.7 percent was hydropower. Its annual power output was 104.2 billion kWh, of which hydropower provided 11.07 billion kWh or 10.6 percent. The grid's largest power generation load was 14,330MW and its maximum peak-to-valley differential was 5,525MW.

The northeast is China's primary industrial base area. As our national economy develops and people's living standards improve, power use loads have grown quickly. The rate of growth in demand for electric power has exceeded the rate of growth in power output, peak-to-valley differentials have continued to grow, and there is a shortage of peak regulation power sources. These have resulted in extremely irrational phenomena of the grid restricting power at peak loads and being forced to shut down generators during valleys in cold reserve.

B. Main Problems Facing the Grid

1. Insufficient power sources. Starting in the early 1970s, the pace of power construction in the Northeast China Grid has consistently lagged behind the rate of growth of our national economy. During the Seventh 5-Year Plan, its installed generating capacity grew at an average annual rate of 8.0 percent, which was 1 percent lower than our national average. The grid has serious power shortages and an installed generating capacity shortage of about 4,000MW. Its power output shortage is about 20 billion kWh. In 1990, the average daily restricted power load was 1,708MW.

2. Insufficient electric power for peak regulation. Rapid growth in the Northeast China Grid's power use loads, changes in the structure of electricity use, and significant changes in the characteristics of system loads have caused peak-to-valley differentials to rise each year, from 1,640MW in 1980 to 5,525MW in 1991. However, the proportion of installed hydropower generating capacity which has primary responsibility for peak regulation functions has declined each year, from 44 percent in 1957 to 16.7 percent in 1991. At the end of 1991, the grid's total installed hydropower generating capacity was 3,920MW, while the actual amount of hydropower involved in peak regulation capacity was 2,500MW, which is about 47 percent of the peak-to-valley differential, so there is an additional 3,000MW in peak regulation capacity that must be borne by thermal power generators. Projections indicate that the maximum peak-to-valley differential will reach 13,760MW in 2000, so there will be an even greater shortage of peak regulation power.

3. Energy resource shortages. Northeast China has a heavy industry type economic structure in which the raw materials industry is the main factor. In 1989 its energy resource consumption per 10,000 yuan in industrial value of output was 82.62 tons, which was 13.56 tons higher than the national average. The northeast China region's industrial value of output accounts for 15 percent of our national total, including about 20 percent of our national heavy industry value of output, but the region has only 63.7 billion tons of coal reserves, just 9 percent of our national total, and they are developing slowing. Northeast China also has limited conventional hydropower resources, just 2.3 percent of China's theoretical reserves. It has 14,188MW of developable and usable hydropower resources, just 2 percent of our national total, and it is developing slowly.

4. Capital shortages. The main reason that the northeast China region's coal and electric power industries have developed slowly is a shortage of capital. During the Seventh 5-Year Plan, the State invested 4.14 billion yuan in capital in electric power construction in the Northeast China Grid, just 8.9 percent of the national total (46.3 billion yuan). The investment in hydropower was even smaller, only 750 million yuan, equal to 5.9 percent of the region's total investments in electric power (12.7 billion yuan).

II. Accelerate Hydropower Development, Fight To Build 5,000MW

The energy resource shortage is the primary factor restricting China's national economic development, and major efforts to accelerate hydropower construction are an important part of northeast China's energy resource development strategy. Currently, the northeast China region's installed hydropower generating capacity, as a

proportion of the region's total installed generating capacity, has been declining each year and is expected to fall to 13 percent by 1995. The development and utilization rate of hydropower resources is rather low, about 27 percent. Growth in installed hydropower generating capacity has been slow, averaging 3.4 percent annually from 1986 to 1990. This situation obviously cannot meet economic development requirements. For this reason, electric power industry construction prior to 2000 and in the future should take full advantage of hydropower resources and make major efforts to develop hydropower. In particular, we should seize the great opportunity at present to accelerate and intensify reform, move hydropower construction in the northeast China region up to a new stage (doubling [the capacity]), and fight to build 5,000MW in installed generating capacity.

A. The Northeast China Grid's Need for Hydropower

1. To solve the large grid's peak regulation, frequency regulation, and accident reserve problems, ensure safe and economical operation, and increase the number of utilization hours for thermal power generators, its installed hydropower generating capacity should comprise 25 to 30 percent of its total installed generating capacity. Based on this estimate, the installed hydropower generating capacity required by northeast China region as a whole will be 10,000MW in 2000 and 25,000MW in 2020.

2. Hydropower has primary responsibility for grid peak regulation tasks and assumes responsibility for peak load operation in daily load charts. The grid will require a peak regulation capacity of 13,760MW in 2000 and hydropower will have to be responsible for 10,000MW. The daily operation time for hydropower should be three to five hours. Prior to 2000, the Northeast China Grid will place a large number of 300MW and 600MW thermal power generators and nuclear power plants into operation in succession, growth in household electricity consumption in its power use structure will continue to be greater than growth in industrial electricity use, load rates will also drop, and peak-to-valley differentials will become larger, so it would be best for the number of utilization hours for hydropower generators to be 1,300 to 1,600 hours/year.

B. Accelerate Construction of Conventional Hydropower Stations

Based on the northeast China region's hydropower resource distribution characteristics, development conditions, and peak regulation requirements, we should accelerate the development of conventional hydropower stations in the three provinces over the next decade and strive to complete 1,540MW of capacity by 2000. The main projects are: two medium-sized cascade power stations at Gaoling and Jinkeng in Liaoning Province with a design total installed generating capacity of 145MW (I suggest 240MW). In Jilin Province, the Songjiang He cascade power station with a total installed generating capacity of 510MW, where preparations to begin construction are now in progress, and Liangjiang power station with a planned installed generating capacity of 60MW (I propose 120MW). In Heilongjiang Province, Lianhua hydropower station with a total installed generating capacity of 550MW where construction is now underway and Xin'e power station with a planned installed generating capacity of 100MW (I propose 120MW).

C. Accelerate Construction of Pumped-Storage Power Stations

Pumped-storage power stations have dual roles in peak regulation and filling valleys. They can serve as fast emergency accident reserves in electric power systems and improve the reliability of grid power supplies, and they have become a publicly-acknowledged economical peak regulation power source all over the world.

Liaoning and Heilongjiang provinces have already done pumped-storage power station planning and reliability research work and Jilin Province plans to undertake planning work in an effort to complete 2,950MW of pumped-storage power stations by the year 2000. The main projects are the first-phase project at Pushi He pumped-storage power station in Liaoning Province which will have a total installed generating capacity of 1,000MW and an ultimate capacity of 2,000MW, and an effort will be made for a formal construction start in 1995. A second one is Huanggou pumped-storage power station in Heilongjiang Province, with a total installed generating capacity of 1,200MW. This power station will use Lianhua hydropower station as its lower pool, so it would be best if its construction was synchronized with Lianhua hydropower station. I suggest that preparations for construction be made in 1994 and that construction be formally started in 1995. Another project is Baishan pumped-storage power station in Jilin Province, where I propose a total installed generating capacity of 750MW and a formal construction start in 1996.

D. Accelerate Construction of Expansion Projects at Old Hydropower Stations

Because the northeast China region has very few hydropower resources, it should consider gradual expansion of old hydropower stations while it is building new hydropower stations. During the 1970s we expanded Jingpo Hu hydropower station (expanded capacity 60MW) and in the 1980s we also expanded Shuifeng power station (on an international river) and added 135MW of capacity. In 1992, the Baishan second phase and Fengman second phase expansion projects were placed into operation, with 600MW at Baishan second phase and 170MW at Fengman second phase, which increased the northeast China region's total installed hydropower generating capacity to 4,305MW (including an expansion of 965MW). By the year 2000 we will strive to make an additional expansion of 670MW in installed generating capacity, which will mainly include the Fengman hydropower station third phase project with an

installed generating capacity of 280MW where a construction start is expected in 1993 and an effort will be made to place the first generator into operation to generate power by the end of 1995. Another project is the second phase project at Hongshi hydropower station which will have an installed generating capacity of 120 to 140MW where we will strive to begin construction in 1995, and we should speed up preparatory work. Huilongshan hydropower station will have an installed generating capacity of 120MW, and I suggest that the preliminary design be completed in October 1993, the project should be established in 1994, and construction should begin in 1995. At the Huanren hydropower station second phase project, for historical reasons the normal water impoundment level at Huanren hydropower station has been lowered 32 m and the installed generating capacity reduced by one-half. The most ideal program is to increase the height of the large Huanren dam and raise the normal water impoundment level, which could increase the installed generating capacity by 200 to 300MW. However, because of the extreme difficulty involved in requisitioning the land and resettling the population, in the present stage we can only do research on how to increase the installed generating capacity without increasing the height of the large dam. The preliminary research plans to utilize two middle openings in the dam to increase the installed generating capacity by 100 to 150MW, and I propose that preparatory work be speeded up.

E. Spur Development and Construction of Boundary River Power Stations

International rivers account for about 25 percent of the northeast China region's hydropower resources, with about 3,000MW on the Heilong Jiang, about 1,200MW on the Yalu Jiang, and about 110MW on the Tumen Jiang. Thus, we must think of ways to create the conditions to develop and utilize international rivers.

At present, Linjiang hydropower station on the Yalu Jiang has an installed generating capacity of 400MW/2 and examination of the preliminary design has been completed. I suggest that the Sino-Korean Council focus on working with the Korean side and try to complete it and foster its benefits by 2000.

III. A Strategic Program for Hydropower Development in Northeast China for 2020

After 2000, as industry and agriculture develop, the Northeast China Grid's installed generating capacity will more than double, which will also require substantial development of hydropower. The overall development principle is a combined focus on building conventional hydropower stations and pumped-storage power stations. Conventional power stations will be focused on the Heilong Jiang and Nen Jiang, while pumped-storage power stations will be centered mainly on Liaoning and Heilongjiang provinces. The main projects are: in Liaoning Province, the Pushi He pumped-storage hydropower station second phase project with an installed generating capacity of 1,000MW, Buyunshan pumped-storage power station with 1,000MW, and the Qingshiling pumped-storage first phase project with 1,760MW. In Jilin Province, they are Linjiang hydropower station with 400MW/2, Manjiang hydropower station with 150MW, and Hadashan key water conservancy facility hydropower station with 80MW. In Heilongjiang Province, they are Erdaogou hydropower station with 50MW, Changjiangtun hydropower station with 210MW, Mohe hydropower station with 2,000MW/2, Lianjin hydropower station with 1,000MW/2, Sanjianfang pumped-storage power station with 900MW, and Wuchang pumped-storage power station with 2,025MW. In eastern Inner Mongolia, they are: Nierji key water conservancy facility hydropower station with 250MW, Liujiatun hydropower station with 125MW, and Gugu He hydropower station with 175MW.

After 2000, these three provinces and one autonomous region should first develop Mohe and Lianjin power stations on the trunk of the Heilongjiang and conventional hydropower stations on the Songhua Jiang and Nen Jing, while at the same time accelerating construction of Buyunshan, Wuchang, Sanjianfang, and other pumped-storage power stations in Liaoning and Heilongjiang provinces, for a projected total installed hydropower generating capacity of 19,943MW by 2020.

IV. Primary Measures That Should Be Adopted

A. Accelerate Preparatory Work, Increase Design Reserves

One characteristic of hydropower station construction is a long period of preparatory work and large investments. Moreover, doing good preparatory work for hydropower is also the foundation for hydropower construction. Thus, on a foundation of doing good river basin planning and electric power planning, we certainly must do design and optimization work well, and fully foster the decision-making role and flexible role of designs in hydropower construction to meet the requirements for design document compilation, examination and approval, and reporting of project establishment, start of construction, and progress in project construction in order to attain the objective of shortening construction schedules and conserving project investments.

At present, capital shortages for hydropower preparatory work in the northeast China region have resulted in very few design reserve projects and seriously inadequate reserve strengths. For this reason, I propose that we set aside 3 to 5 percent each year from the major overhaul and upgrading funds for hydropower stations that are already generating electricity, about 4 to 6 million yuan, for hydropower planning, feasibility research, and preliminary design work. After a project is established it can be repaid or continue to be used as preparatory work funds.

Grid bureaus (provincial bureaus) should focus on preparatory work in a planned manner and strengthen their

relationships with design departments and local governments in an effort to have more reserve projects for selection.

B. Establish Stable Hydropower Construction Funds

If we wish to accelerate hydropower development in the northeast China region, a prominent issue is providing the investments. This is only possible by relying on reform and policies. In the future the state cannot substantially increase its investments in hydropower, so we can consider adopting the following measures.

1. First, we must set aside 0.02 yuan per kWh from the power generated by hydropower and invest all of it in hydropower construction. At present, the Northeast China Grid is generating 7 to 10 billion kWh of hydropower annually, so this could raise 140 to 200 million yuan in capital. The construction funds that are set aside should be under unified calculation and deduction and unified control of the grid to change from the method of turning them over to the local area for management. This could reduce unnecessary functional organizations and guarantee rational utilization of the capital.

2. We must actively promote the raising of capital via multiple channels and from multiple areas, fully foster the initiative of central authorities and local areas, and undertake inter-provincial and inter-enterprise joint hydropower development. For example, Heilongjiang Province and Inner Mongolia could jointly develop hydropower stations on the Nen Jiang. We must also increase the number of hydropower utilization hours and give hydropower's peak regulation to a portion of thermal power's increased power output that is used to compensate for newly built hydropower stations to be able to entice enterprises to invest in hydropower.

3. We should raise it from existing hydropower station benefits, repay the interest to banks for those cases in which the original investment was in the form of bank loans, repay the principal and then re-borrow loans to be used for hydropower development. We should implement peak and valley electricity prices and expand the differential. Newly built hydropower stations should implement new prices for new electricity sources and adopt prices equal to those of thermal power for electricity supplied to the grid. On this basis, calculate the power generation benefits of hydropower and use part of this capital as investments in hydropower construction.

We can also implement continuous development of cascade power stations by using the benefits from power generation from the previous power station for continued investment in building the next hydropower station, establish funds, engage in rolling development, and do continuous construction. We can also study issuing bonds, repaying the principal and interest after going into operation, and other measures.

C. Intensify Reform of the Hydropower Construction System

China's reform and opening up have now entered a new development stage. Northeast China's hydropower development and construction should seize this favorable opportunity, further liberate ideology, transform concepts, accelerate hydropower construction, and strive to move up to a new stage.

1. The grid bureau must strengthen unified management work over hydropower development and construction, improve understanding, and implement organization. This means that it should establish specialized organizations such as a Northeast China Hydropower Development and Construction Corporation, or call it the Hydropower Development and Construction Project Department to assume responsibility for long-term hydropower programs, feasibility research, preliminary designs, bidding, project management and construction examination and acceptance, production and operation, and other work. Only in this way will unified arrangements and rational deployments appear in hydropower development in the northeast China region and create a new situation of design reserves for conventional, pumped-storage, and old hydropower station expansion with rational time-sequence development and gradually achieve river basin management (the "four remote things").

2. Comprehensively implement a proprietor responsibility system, bidding contractual responsibility system, and construction supervision and management system, and the grid bureau should strengthen its macro control over projects. Project supervision and management should adhere to giving responsibility to proprietors. The basis of supervision and management work is the signing of contractual responsibility contracts between proprietor units and construction units, approval of design documents, rules, regulations, decrees, and laws promulgated by the state, and instructions from proprietor units during the implementation process. Project supervision and management represent proprietors in supervising the entire process of project implementation, primarily through supervising progress, quality, and finances. Supervision is used to spur and assist contractual responsibility units in fully completing their contractual tasks.

3. Implement bidding or negotiated bidding for design and equipment manufacturing. Proprietors manage design units and manufacturing plants according to contracts, spur them to adopt advanced design standards, apply advanced technology, optimize programs and designs, reduce the amount of engineering, and shorten construction schedules to attain the goal of conserving investments.

4. Accelerate internal reforms in hydropower construction staffs. Currently, this type of large and complete engineering bureau, which is like a small society, is incapable of adapting to the new situation in major

hydropower development, so I propose establishing specialized crack hydropower construction staffs to move construction enterprises out of their difficult straits as quickly as possible. Select people with high professional levels and organizational abilities to strengthen leadership and command on the first line of hydropower construction, reorganize staffs, establish quality supervision systems, raise construction technology levels, strengthen internal accounting, and so on to meet the requirements of the hydropower construction situation.

The hydropower construction tasks of the northeast China region in the future are magnificent as well as extremely arduous. If they rely on reform and policies and strive shoulder-to-shoulder, the expected goal of doubling the installed hydropower generating capacity can certainly be achieved.

Thermal Power

Work on Manas Plant Proceeding Smoothly

946B0025A Urumqi XINJIANG RIBAO in Chinese 31 Oct 93 p 1

[Article by reporter Kang Wenhua [1660 2429 5478]: "Manas Power Plant Second Phase Expansion Project Proceeding Smoothly"]

[Text] When the two 100MW generators are formally placed into operation, they will increase the Urumqi region's power generating capacity by more than one-fourth! Thus, "guaranteeing that the No. 5 generator is formally placed into operation during the second quarter of 1994 and striving to place the No. 6 generator into operation by the end of 1994" have become the increasingly urgent goals of the builders of the Manas power plant second-phase expansion project.

A key state project during the Eighth 5-Year Plan and a key project of Xinjiang Uygur Autonomous Region, the second-phase expansion project at Manas power plant (two 100MW generators, the No. 5 and No. 6 units) will involve a total investment of 375 million yuan. Since the ground was broken to start construction on 1 September 1992, an investment of 180 million yuan has been completed.

Agreement With Singapore To Build 2,400MW Plant in Ningbo

946B0025B Beijing RENMIN RIBAO in Chinese 26 Nov 93 p 1

[Article by reporter Fan Weiguo [5400 0251 0948]: "China and Singapore Will Jointly Build a Large Power Plant with a Total Capacity of 2,400MW with a First-Phase Investment of 5.5 Billion Yuan"]

[Text] The first cooperative development agreement between China and Singapore to build a large electric power project, Yinglongshan power plant at Ningbo, Zhejiang Province, was signed on 25 November 1993 in Ningbo.

The Chinese joint investment unit is the Zhejiang Electric Power Development Company and the Singapore joint investment party is the Shengbaowang Engineering and Development (Private) Company, Ltd. This coal-fired power plant will have a total installed generating capacity of 2,400MW and the first phase investment will be 5.5 billion yuan renminbi, with each of the two parties investing 50 percent of the capital and forming the Chinese-Foreign Cooperation Ninglong Power Generation Company.

The Ninglong Power Generation Company's site has been selected near Xianxiang Town in Yin County, Ningbo, beside Xiangshan Bay on the East China Sea, and the project will occupy about one square kilometer of land. Two 35,000-ton-grade coal piers and a 3,000-ton-grade large equipment receiving and unloading pier will also be built in conjunction with the project.

Construction of this project may begin during the first quarter of 1995. Construction of the project will be done through contractual responsibility by the two joint investment partners with each fostering its advantages. After the power plant has been completed and in operation for 20 years, it will be transferred to the Zhejiang Province Electric Power Bureau.

Shengbaowang Engineering and Development (Private) Company, Ltd. is a subsidiary of Singapore's Shengbaowang Group Company. Shengbaowang Group Company is a large well-known Singapore company and is involved in the shipbuilding industry, maritime petroleum projects, and other projects.

Trends of Superconducting Magnetism Energy Storage Technology Development

94P60209A Shanghai DONGLI GONGCHENG [POWER ENGINEERING] in Chinese Vol 14 No 1, Feb 94 pp 50-53

[Article by Zhang Xiubin [1728 4423 1755] of Shanghai Jiaotong University and Nie Xiaodong [5119 2556 0392] of Jiangsu Electric Power Test Institute]

[Excerpts] [Passage omitted]

Prediction of China's Electric Power Generation and CO_2 Emission

Today, thermal power plants are the main sources of CO_2 emission. When coal is burned to generate electric power, CO_2 released accounts for 60 percent of the total greenhouse gases. According to the article on "Global Climate Change and Development of China's Energy Resources" published by Zhu Bin [2612 2430] in ENERGY OF CHINA (No 5, 1993) [See JPRS-CEN-93-010, 5 Nov 93, pp 23-27], although China ranks third in total CO_2 discharge—behind the United States

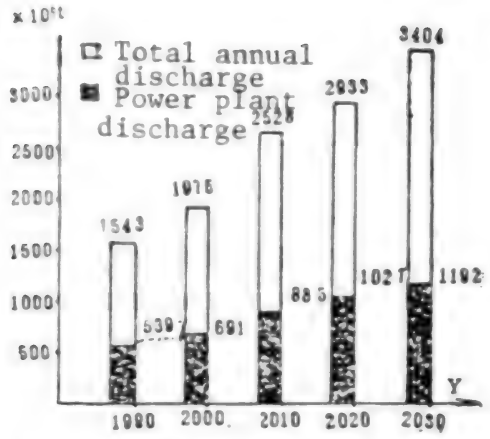

Figure 2. Future CO_2 Emission in China

and the former Soviet Union—China's total CO_2 released by coal-burning ranks top among the three countries. By using Zhu Bin's method, a bar chart demonstrating China's future CO_2 emission is shown in Figure 2 below. Shadowed areas are CO_2 released by power-generating plants, which accounts for 35 percent of total CO_2 emission.

According to information provided in the article on "Transaction on Energy Conversion" published in IEEE [1992.7(2)], which stated that if, for the power plants, Superconducting Magnetism Energy Storage (SMES) is used to replace oil-fired or gas-burning units of 1 percent of total installed capacity, CO_2 emission will be reduced by 1.6 percent. If SMES is used to replace 1 percent of the coal-fired units in China, then CO_2 emissions could be further reduced by 2.4 percent or more. Table 1 shows predicted data of gradual decrease of CO_2 emission resulting from gradual replacement of oil-fired and gas-burning units by SMES in China.

Table 1. Decreasing CO_2 Emission Resulting From SMES Replacement (x 10^6t)

SMES ratio (%)	Year 2000	Year 2010	Year 2020	Year 2030
1	16.59	21.23	24.64	28.60
3	49.76	63.70	73.92	85.79
5	82.94	106.16	123.21	142.99

[Passage omitted] The author of this article is suggesting that while China strives to establish a non-carbon energy generation system, it should also consider research on SMES technology, and SMES research should also be covered in the "Torch Program" for the next Five-Year Plan. If China fails to do so, it will again lag behind other nations in the area of electric power construction.

Daba Update

94P60242 Yinchuan NINGXIA RIBAO in Chinese 21 Apr 94 p 1

[Summary] On 18 April work officially got under way on the second phase of construction of the Daba power plant, a major item under the 8th Five-Year Plan. In phase two of the project, two 300MW generating units will be installed at an estimated investment of over 1.1 billion yuan. To date, foundation work on the stacks, cooling towers and main plant buildings has been completed and the site has water, power and roads. The two 300MW units of Daba phase two will go into operation in early 1996 and early 1997. Total construction time will be 36 months, 12 months less than the time necessary to complete phase one of the project. After phase two has been completed, the installed capacity of Daba will be 1200MW, making it the first thermal power plant in Ningxia to exceed 1000MW.

Beilungang No. 2 Unit Joins Grid

94P60243 Hangzhou ZHEJIANG RIBAO in Chinese 5 Apr 94 p 1

[Summary] On 2 April, the No. 2 generating unit of the Ningbo Beilungang power plant joined the grid. The Beilungang power plant is a major State construction project and has a design installed capacity of 2400MW (four 600MW generators). Investment in the first phase of the project is 2 billion yuan (phase one calls for the installation of two 600MW units). Of this investment, $3.9 million is being lent by the World Bank. The major equipment is being imported from the United States, Japan, Canada, France, and Switzerland.

Coal

Shanxi Scientists Put Latest Research to Practical Use

946B0024B Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 11 Oct 93 p 2

[Article by reporter Jin Kai [6855 0418] "Major Advances in Applied Research on Coal Body Permeability Theory; Shanxi Mining College Scientific Research Personnel Apply Their Newest Research Achievement in Coal Production With Significant Economic Results"]

[Text] Shanxi Mining College professor Ma Guangdi [7456 0342 4574], associate professor Zhao Yangsheng [6392 7122 0581], and others have used the coupling action of coal body deformation and water transfusion to do research on coal body water injection theory and applications, and they have directly applied their achievements in coal industry production.

Coal seam water injection is an engineering standard during the coal mining process to reduce coal dust and

prevent gas eruptions and the occurrence of shock ground pressures. Because China has no experimental standards for coal permeability coefficients and coal body water conduction coefficients had never been measured, on-site water injection mostly depended on experience and water injection at most mines depended on their situations, so it was difficult to obtain the expected results.

To undertake intensive research work on this topic, Ma Guangdi, Zhao Yangsheng, and others developed their own coal and rock body water conduction coefficient experimental console and triaxial stress measurement instrument. They can use this equipment to conduct research on coal and rock samples measuring 100 x 100 x 200mm. These dimensions are eight times those of samples measured using similar experimental equipment in foreign countries. It provided the conditions for doing research on coal and rock pore and crack permeability, and it can be used to study the permeability of softer rock. In addition, they conducted 300 x 300 x 300mm coal sample tests and derived the conclusion that the dimensions of coal bodies do not change their permeability.

They also collected coal samples from China's seven big unified distribution coal mines and conducted a large amount of experimental research in the laboratory on coal bodies that contain pores and cracks. They derived a mathematical model for water conduction coefficients under the effects of three-dimensional stress and pore water pressure, and the laws of coal body deformation and effective stress caused by pore water pressure, and produced a correction formula for the (Taishaji) principle. These research achievements have laid a solid foundation for coal seam water injection

On the basis of a large amount of basic research, they have conducted industrial experiments at Datong, Lu'an, Xishan, and other coal mines in Shanxi Province. They successfully conducted a coal seam water injection shock ground pressure prevention experiment that enabled the safe extraction of 140,000 tons of coal in one year from this work face. Their softening of moderate hardness coal seams using coal seam water injection overcame a problem in mining roof coal in moderate hardness coal and led to success in a skylight coal mining method which produced 1.65 million yuan in economic benefits for this mining bureau in one year. Their water injection dust reduction experiments have achieved a gratifying on-site result of a 63.2 percent reduction in dust.

They are now working on a scientific research project for the Ministry of Coal Industry in which they will complete research on the water conduction properties of coal samples from all of China's primary coal mines and will propose a water conduction characteristic classification program.

Government Decides To Accelerate Development of Southern Coal Base

946B0031A Guiyang GUIZHOU RIBAO in Chinese 12 Nov 93 p 1

[Article by GUIZHOU RIBAO reporters Xiao Caizhong [5135 2088 1813], Wang Bing [3769 0365], and Li Zhu [2621 4591]: "State Decides To Accelerate Development of Jiangnan's Coal Capital; In the Near Term It Will Build a Multiple Railway from Liupanshui City to Zhuzhou, the Shui-Xiao Railroad from Shuicheng to Panxian, and the Nei-Kun Railroad from Neijiang to Shuicheng; Railroad Transportation Capacity Will Be Increased 10-Fold After 5 Years"]

[Text] The State recently decided to make a large-scale investment in railroad and highway construction at Liupanshui City to increase the intensity of development of Jiangnan's [area south of the Chang Jiang] Coal Capital. Liupanshui City will become a transportation node forming the Gui-Kun [Guiyang-Kunming] Railroad, Nan-Kun Railroad, Nei-Kun [Neijiang-Kunming] Railroad, Zhu-Liu [Zhuzhou-Liupanshui] Multiple Railroad, Shui-Xiao [Shuicheng-Panxian] Railroad, and Pan-Bai [Panxian-Baise] high-grade highway, running north to Chengdu, west to Kunming, south to Beihai and Fangcheng, and east to Guiyang and Zhuzhou, making it a key communication hub for southwest China.

Liupanshui City is south China's biggest coal base area, but because of communication limitations, it has had overstocks of millions of tons of raw coal, coking coal, and refined coal every year for many years. At the same time, demand for coal has been constantly growing in nearby Guangxi, Guangdong, Hunan, Sichuan, Yunnan, and other provinces and autonomous regions and some enterprises have had to shut down because of coal shortages. The 10 million tons-plus of coal produced each year in the Liupanshui Mining Region have only been able to rely on the Gui-Kun Railroad and Panxi Railroad branchline which have been overloaded for many years, so the important role of Jiangnan's Coal Capital has been hard to foster due to communication restrictions.

During the past several years, because of the extremely acute energy resource shortages in the south China and southwest China economic regions, the state has been reconsidering the role and status of the new energy resource city Liupanshui City. It has included Liupanshui in the state's Panxi-Liupanshui resource development zone, and it has decided to invest in the short term 10 billion yuan to develop Liupanshui's energy resource and raw materials industries and has started with a large-scale investment in communication construction for Liupanshui to turn it into a railroad crossroads within five years. The Panxian section of the Nan-Kun Railroad which is already under construction is now being speeded up. Preparations for the initial engineering for the Shui-Xiao Railroad from Shuicheng to

Panxian are now ready, and it is possible that construction may begin soon. A decision has already been made for a short-term return of construction on the Nei-Kun Railroad from Neijiang in Sichuan to Kunming in Yunnan and to connect it at Dawan in Shuicheng. The additional line for the Liupanshui to Zhuzhou, Hunan Railroad is now being surveyed and plans call for it to be opened to traffic in five years. The site for southwest China's biggest railroad marshalling yard has now been chosen at Shilong Village in Fenghuang Township, Zhongshan Prefecture. Construction of the Pan-Bai high-grade highway from Baise in Guangxi to Panxian in Guizhou is now underway. A preliminary discussion has already been conducted for the project to extend the Gui-Huang high-grade highway to Shuicheng. It has been projected that within five years Liupanshui's railroad transportation capacity can be increased almost 10-fold compared to now, and the density of its railway network will be the greatest in southwest China.

Since large-scale development in the 1960s at Liupanshui, the 1990s have welcomed a second golden era. The economic development program recently approved by the State Council fully confirms the strategic status and important role of Liupanshui in south and southwest China's economy and has included development of Liupanshui in the state's important orders of the day to turn Liupanshui in the short term into one of south China's biggest heavy industrial cities and a communication hub.

Oil and Gas

Daqing Solves Problem of High-Water-Content Wells

946B0024C Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 22 Oct 93 p 2

[Article by Fan Likai [5400 4539 0418] and Li Shuben [2621 2885 2609]: "Daqing Solves a Problem in Developing High-Water-Content Oil Wells. Yearly Output in Later Periods Can Still Be Maintained at 50 Million Tons"]

[Text] A worldwide problem in oil field development that urgently requires a solution, "submerged strata well logging interpretation technology," has now been solved at Daqing Oil Field.

Daqing Oil Field is now entering the late period of high water content development and has an overall water content as high as 80 percent, which poses a serious threat to Daqing's ability to attain its objective of 50 million tons of sustained and stable yearly crude oil output.

In early 1992, Daqing Oil Field Management Bureau organized a key attack to study the worldwide problem of submerged well logging interpretation, and it has now made an important breakthrough. They have now produced a feasible method for thick strata residual oil saturation logging interpretation, thin strata position determination, and high platform oil strata submerged strata logging interpretation. After placing several 10 wells into operation for confirmation, the coincidence rates were, respectively, 89.1 percent, 87.4 percent, and 85.3 percent.

Daqing Oil Field has now completed submerged strata interpretation for 3,628 wells, at an average interpretation coincidence rate of 85.7 percent. The related technical personnel have used the new "813 submerged strata integrated interpretation technology" to interpret 115 readjustment wells for Daqing's No. 6 Oil Extraction Plant with a coincidence rate of more than 80 percent.

'Artificial Island' Marks Step Forward in Drilling Technology

94P00217 Beijing RENMIN RIBAO [PEOPLE'S DAILY OVERSEAS EDITION in Chinese 11 Sep 94 p 1

[Text] China's first artificial island—the Dagang oil field Zhangjuhe artificial island—recently achieved a high-output industrial flow of oil and gas.

The Zhangjuhe artificial island is located on the southeast coast of the village of Zhangjuhe, Qikou Township, Huanghua City, Hebei Province, 4,661 meters offshore. The complex is a round steel caisson measuring 11 meters in height; it weighs more than 700 tons and covers an area of 2,826 square meters. The 'island' can accommodate 72 wells. The first well began drilling in early August 1993.

Today, three exploratory wells have been drilled at Zhangjuhe and one of them—the Zhanjihu 2-1 well—recently hit a high-output industrial oil and gas flow with a daily output of 1,563 cubic meters of natural gas and 74.74 cubic meters of crude oil.

The success of the exploratory wells at Zhangjuhe illustrate the fact that China has reached a new stage in shallow ocean oil exploration.

Another Medium-Sized Field Verified in Northern Tarim

94P00239 Beijing RENMIN RIBAO [PEOPLE'S DAILY OVERSEAS EDITION in Chinese 7 Jan 94 p 1

[Text] Recently, the Northwest Petroleum Geology Bureau of the Ministry of Geology and Mineral Resources verified a medium-sized oil and gas field with impressive geological reserves. The field is located in the northern part of the Tarim Basin in Kuqa Xian, Xinjiang Province.

The field has been named the "Western Dabiya" oil and gas field and it covers an area of 11.5 square kilometers. The deposit has a thickness of 1,174 meters.

ARCO Aims To Help China Develop Low-Cost Petrol

40100049A Beijing CHINA DAILY [ECONOMICS] in English 12 Apr 94 p 2

[Article by Chang Weimin: "ARCO Aims to Help China Develop Low-Cost Petrol"]

[Text] The American oil giant Atlantic Richfield Company (ARCO) aims to help China develop low-cost and reformulated petrol.

China, which expects to assemble 3 million motor vehicles annually within 10 years, badly needs new kinds of petrol that can improve vehicle efficiency and reduce air pollution.

ARCO President Mike R. Bowlin said yesterday in Beijing he is in the country to conduct negotiations with Chinese government officials.

"We'll discuss the possibilities for the cooperation and market of products to be manufactured," said Bowlin, who will be ARCO's chief executive officer later this year.

China now has 8.3 million vehicles, which consume 25 million tons of fuel a year. Most of the fuels contain lead.

ARCO, one of the major foreign oil cooperative partners of China, is the top developer of low-cost petrol in the United States.

Bowlin said the firm is also interested in coal mining and generating electricity with coal and natural gas in China.

During his trip, Bowlin is expected to talk with Vice Premier Zou Jiahua, high-ranking officials from the State Planning Commission, and senior executives from the China National Petroleum Corporation, the China National Offshore Oil Corporation (CNOOC), the China Petroleum Corporation and the China Huaneng Group, a central-supported energy conglomerate.

A CNOOC official and Bowlin both announced that the two corporations will join efforts to develop crude oil outside China.

Bowlin said ARCO, whose revenues last year stood at $20 billion, will continue to target China as one of its key markets.

Although Bowlin came to China expecting only to conduct negotiations this time, agreements are expected to be clinched later in the United States.

ARCO began doing business with China in 1978 and has been one of the largest partners with Chinese oil firms so far. It has already sunk $300 million into oil exploration in China and expects its investment to increase by $1.2 billion by 1996.

ARCO has signed several contracts and agreements with Chinese for developing oil and natural gas in the South China Sea and exploring for petroleum in the East China Sea.

According to the contracts, ARCO, together with CNOOC and the Santa Fe Company, are to annually supply Hong Kong with 2.9 billion cubic metres of gas beginning in 1996.

ARCO discovered the Yacheng 13-1 gas field, the largest offshore field in China, which contains 100 billion cubic metres of gas.

Search for Oil To Be Intensified

40100049C Beijing CHINA DAILY [BUSINESS WEEKLY] in English 11 Apr 94 p 8

[Article by Chang Weimin]

[Text] China is to beef up prospecting for new reserves of crude oil in its eastern part, where major oilfields are concentrated.

The efforts are expected to verify enough reserves to make up for declining production in old oilfields.

Fields in the eastern part produce some 124 million tons of oil a year. In addition, five oil-bearing areas are to be developed in the next three years and are expected to yield at least 10 million tons of oil annually.

Due to decades of exploitation, production of some old oilfields has slumped over the past three years.

New technology will be used to recover more oil from old fields and to develop heavy and super-heavy oil.

Measures for that purpose were outlined at what was billed as a "historic" conference held late last month by the China National Petroleum Corp. (CNPC).

A senior official from CNPC's Production and Development Department last week said the measures have raised the confidence of Chinese.

In an interview with BUSINESS WEEKLY, the official, who declined to be identified, said the five oil-bearing areas will be part of a "second battlefield" to launch major manoeuvres by the energy industry.

The areas include the Liangjiang district of the Songliao Basin, a block covering parts of Ningxia Hui Autonomous Region and the provinces of Shaanxi and Gansu, and the shallow waters of the continental shelf in the Bohai Bay.

If successful, the measures will ensure that annual oil production in the eastern part remains above 124 million tons in the next seven years.

Last year onshore oilfields produced 139 million tons of oil.

China has expertise in enhancing the recovery of oil from oilfields, but the official said major efforts are necessary to perfect the expertise and to develop new technology.

The official spoke highly of last month's conference, saying it was rare that nearly all senior officials and experts engaged in onshore oil production attended the week-long conference.

The official reiterated the importance of stabilizing production in the eastern part as a precaution in case big discoveries are not made soon in the Tarim, Turpan-Hami and Junggar basins in Xinjiang Uygur Autonomous Region. The three basins are expected to be the core of oil production in the next century.

Some Chinese are wondering why the country, which lacks enough energy for an economy of 1.18 billion people, does not buy more oil from overseas when prices are only about $13 a barrel.

Instead, high-ranking officials and oil industry professionals seem to have worked out various plans for drawing every drop of oil out of the ground.

Officials from all different sources have ruled out raising oil imports because the country lacks the foreign currency to pay for it.

China's imports of oil have been on the rise over the past several years and this year will be equal to exports.

But next year the country is likely to become a net importer of oil. Experts predict demand for crude oil will exceed planned production.

China imported 15 million tons of oil in 1993, compared with 12.31 million in 1992. Last year oil exports were 19 million tons, 1.7 million less than in 1992.

Ups and Downs in Crude Oil Production

40100049D Beijing CHINA DAILY [ECONOMICS] in English 11 Apr 94 p 2

[Article by Chang Weimin: "Ups and Downs Noted for Crude-Oil Output"]

[Text] Production of crude oil increased at several major oilfields but declined at others in this year's first quarter.

Latest statistics show that Daqing, China's largest oilfield, pumped 13.86 million tons in the period from January through March—100,000 tons more than in the same period last year.

Daqing, whose output accounts for 40 percent of China's total, will maintain annual production at more than 56 million tons at least until 1995, and 50 million tons through the year 2000.

Chinese onshore oilfields produced 139 million tons of oil last year.

In the first quarter of this year, the onshore oilfields produced 34.33 million tons, up 0.58 percent over the same period last year.

Output of the Liaohe, Xinjiang and Dagang oilfields during the first quarter were, respectively, 3.6 million tons, up 5.4 percent; 1.95 million tons, up 10.4 percent; and 1.04 million tons, up 4.1 percent.

However, production at some other major oilfields dropped as expected. Most of the country's oilfields, concentrated in Northeast and Central China, have been exploited for decades.

A senior official from the China National Petroleum Corporation (CNPC) says he is confident production at the old oilfields can be maintained. Onshore oil production for this year is expected to be 140 million tons.

The official said measures will be taken to stabilize or even increase production.

CNPC, the country's largest oil firm, intends to beef up investment and technology development in East China, with approval from the central government.

Old oilfields in this region are expected to be the pillar of the country's petroleum industry until at least the year 2000. CNPC's goal is to keep annual production in the East at more than 124 million tons, the official said.

East China reports progress in discovering new oil reserves and working out techniques to exploit heavy-oil reserves and oilfields where geological conditions are used to limit production.

In addition, equipment and expertise to develop shallow offshore waters on the continental shelf have been worked out.

While trying every means to stabilize production in the old oilfields, CNPC will accelerate exploration and development in the Tarim, Turpan-Hami and Junggar basins in West China's Xinjiang Uygur Autonomous Region. Billions of tons of oil reserves in the region are expected to benefit by the national economy in the next century.

Nuclear Power

Nuclear Power Experimental Base Area Established

946B0016A Beijing ZHONGGUO KEXUE BAO [CHINESE SCIENCE NEWS] in Chinese 15 Sep 93 p 1

[Article by Zhai Peitian [5049 1014 1131]: "Nuclear Power Experimental Base Area Being Built in Chengdu; General Secretary Jiang Zemin Is Concerned About the Nuclear Power Industry"]

[Text] During the last part of August, 1993, the State Planning Commission and National Defense Science,

Technology and Industry Commission authorized the China Nuclear Industry Corporation to evaluate construction of a nuclear power base area in Chengdu's Shenxianshu High and New Tech Industry Development Zone and they have approved establishment of the project.

In June 1991 the Academy of Nuclear Power centralized the opinions of experts to develop China's nuclear power industry and sent a written report to General Secretary Jiang Zemin. On 15 June 1991, General Secretary Jiang made important comments regarding acceleration of China's nuclear power base area construction.

According to the general secretary's comments, under the concern and support of the State Planning Commission, National Defense Science, Technology, and Industry Commission, Sichuan Provincial CPC Committee, Sichuan Provincial Government, and China Nuclear Industry Corporation during the past two years, the Academy of Nuclear Power organized the relevant experts to speed up the preliminary design for this project. The Second Academy of Nuclear Industry also gave great support in the preliminary design.

On 29 April 1993, Chengdu City and the Chengdu High and New Tech Industry Development Zone Management Committee organized relevant experts to conduct a preview of the preliminary design. The experts feel that the external conditions for construction of this project have been basically implemented, the design conforms to the state's environmental protection stipulations, and the operational safety and fire-fighting designs were rational.

The new reactor experimental base area is tracking the world's advanced nuclear power technical levels and will build 41 experimental devices including an experimental shock-resistance device, main pump testing console device, control and drive line cold state hydraulic experimental device, three-line earthquake resistance experimental vertical device, complete core hydraulic simulation experimental device, large thermodynamics experimental device, and so on, for the primary equipment for the reactor.

These experimental devices are essential for China's nuclear power development and after they are completed they will assume responsibility for preliminary research on the key technologies of China's nuclear power and for development research for the technology in the initial phase of the nuclear power project, which is very important for achieving a shift to domestic production of nuclear power equipment in China.

Based on the state's needs, the Academy of Nuclear Power will move quickly to work on the engineering blueprint design and construction preparatory work, strengthen management, strictly control investments, determine project quality in accordance with its experimental tasks, start to play a role as quickly as possible, and contribute to the development of China's nuclear power industry.

Hefei HT-7 Tokamak Completed

946B0020A Beijing GUANGMING RIBAO in Chinese 10 Oct 93 p 1

[Article by reporter Xue Changci [5641 2490 6101]: "China Completes Large Superconducting Tokamak Device. A Major Advance That Moves Our Nuclear Fusion Research Into the World's Advanced Ranks"]

[Text] The Chinese Academy of Sciences [CAS] has now invited 12 well-known world fusion scientists headed by professor (Pailunbu), renowned director of the European Community's Ministry of Research, to evaluate the large HT-7 superconducting Tokamak device China has completed at Hefei and the research plans for it.

The experts agree that this newly-completed Tokamak is the most advanced device in developing countries and that it will move fusion research in China into the world vanguard. The quasi-stable state operation carried out in this device is very important for fusion reactors. They feel that the HT-7 device has substantial flexibility and that this research work is very significant for fusion as a whole and that several important technologies can be further developed and applied in industry. The experts approved of the completion of the HT-7 in a very short time and under conditions of extremely limited funds.

The goal of fusion research is to achieve mankind's "ultimate" clean energy resource and is an important topic in man's peaceful use of nuclear energy. The hybrid fusion-fission reactor project in China's high-tech plans is making preparations for producing large amounts of nuclear fuel using hybrid reactors in the next century. During the past 40 years, international fusion research has been relatively concentrated on high-temperature plasma confinement, heating, and other basic questions and has provided a substantial foundation for designing fusion reactors or hybrid reactors. However, there has been relatively little research on how to achieve a stable state or quasi-stable state high-temperature plasma and on its basic properties. Thus, this research project has become one of the realms that attracted the greatest amount of attention in fusion research at the present time, and will be the focus of China's hybrid reactor research for several years into the future.

The HT-7 superconducting Tokamak system was built on the basis of broad-ranging international cooperation by the CAS Plasma Physics Institute and is the world's third largest superconducting Tokamak device at the present time. It has China's largest superconducting magnet system and China's largest low-temperature liquid helium system as well as China's biggest continuous high power microwave system and radio frequency system, more than 20 types of advanced testing and diagnostic systems, and a computer and data collection system that is capable of collecting and processing over 1 million pieces of data each second. Its primary objective is research on high-temperature stable-state plasma

properties and to prepare for achieving continuous operation of Tokamak fusion reactors, which is also a question that is of the greatest concern in fusion research in the world now. Completion of the HT-7 has laid a foundation for China's fusion research to move to the world's leading edge in the next century.

While discussing the construction of the HT-7 device, China's Plasma Physics Institute director and fusion expert Huo Yuping [7202 5940 1627] said that a basic research achievement must be a theory that has not been previously proposed by anyone, a phenomenon or experimental result that has not been observed, or a new experimental method. China's basic research should and must be opened up to the outside world and should participate in competition on a world scale. Only in this way can our basic research very quickly enter the world's leading edge in the entire field. Basic research cannot work only on attaining advanced levels within China. High-level international evaluations in several important fields or important projects are an effective way to spur China's basic research work to enter competition on a world scale as quickly as possible.

Research Lab of High-Flux Engineering Test Reactor

946B0024A Chengdu SICHUAN RIBAO in Chinese 22 Oct 93 p 3

[Article by Zhao Deyi [6392 1795 5030]: "The High-Flux Engineering Test Reactor Research Laboratory"]

[Text] The State has invested 170 million yuan as a first-phase project construction fund for the high flux engineering test reactor in the China Nuclear Power Research and Design Academy's High-Flux Engineering Test Reactor Research Laboratory. Its neutron flux levels rank among the world's leaders and it is number one in Asia. It attained criticality for the first time on 27 December 1979 and has now operated safely for more than 13 years. This reactor is used primarily for nuclear fuel and materials irradiation tests, but it also is used for neutron irradiation technology services and the production of isotopes. The laboratory has 70 engineering and technical personnel including 30 engineers and three senior engineers, and it has 22 senior operating personnel and four operating personnel who have received state reactor operation licenses. Since its completion, this reactor has conducted a series of tests and research on the special types of materials used in nuclear power devices, on UO_2, ThO_2, and UO_2-Gd_2O_3 fuel samples and UO_2 fuel microsphere samples, on reactor pressure vessel steel, and on special types of materials used in high-temperature gas-cooled reactors, fast reactors, hybrid reactors, and other types of advanced reactors. It has carried out development and production of industrial ^{60}Co sources, ^{60}Co flaw detection sources, ^{192}Ir flaw detection sources, ^{60}Co therapy sources and afterloading sources, molybdenum-technetium generators, tin-indium generators, and other radioactive isotopes and R&D on neutron irradiation monocrystalline silicon doping, precious stone irradiation coloring, and other things and produced rather high social and economic benefits.

With the need for rapid development of China's national economy, this laboratory will be playing an ever more important role in nuclear fuel and materials irradiation testing, isotope development and production, neutron irradiation processing, nuclear engineering, radiation chemistry, nuclear medicine, and other high-S&T fields.

Alternative Energy

Tianjin To Develop Geothermal Energy

40100049B Beijing CHINA DAILY [BUSINESS WEEKLY] in English 11 Apr 94 p 2,6

[Text] Tianjin (XINHUA)—To meet the growing demand for energy, Tianjin will develop its plentiful subterranean heat resources.

The city, rich in geothermal energy sources, has reserves of underground hot water estimated at 7.876 billion cubic metres, said an official from the municipal government at a recent conference.

Baodi County, north of Tianjin, has the city's biggest reserves of subterranean hot water, which cover a total area of 8,700 square kilometres. Ten of these heat fields, encompassing 3,074 square kilometres, are especially rich.

Tianjin's underground hot water, with temperatures between 25 and 150°C, is widely used in timber manufacturing, home heating, greenhouses, heated swimming pools, and scientific research.

The Ministry of Geology and Mineral Resources has invested tens of millions of yuan in exploring the city's underground heat resources. The United Nations Development Programme has also invested $5 million.

Tianjin has tapped more than 250 underground hot water reservoirs. The deepest required drilling to a depth of 3,654 metres, and the hottest is 98°C.

The city uses about 38 million cubic metres of underground hot water annually, with thermal energy equal to that produced by 2.5 million tons of coal.

Tianjin is one of the country's biggest underground heat energy centres. More than 140 overseas experts have visited the city to consult on the exploration of underground heat resources.

Businesses from the United States, Iceland, France, Italy, New Zealand and Japan have expressed interest in investing in the development of the subterranean heat resources.

A contract was signed over the weekend between three Chinese companies and a Hong Kong firm to set up a joint venture to build a power station in Xuzhou, Jiangsu Province.

The total investment for the project will be 1.84 billion yuan ($212 million).

The four companies—the State Energy Investment Corporation, Jiangsu Investment Corporation, Xuzhou Investment Corporation, and the Hong Kong-based China Resources (Group) Company Limited—hold 30, 20, 15 and 35 percent of the stake, respectively.

The signing converts the Pengcheng Power Plant from a solely-domestic joint venture into a China-Hong Kong venture. The limited-liability contract has a term of 20 years.

The designed capacity of the power plant is 1.2 million kilowatts. The first phase of the East China project includes two units of coal-fired 300,000-kilowatt generators.

The first unit is expected to be put into operation in September 1996.

Promoting the Development of China's New Energy Resource Technology

946B0068A Beijing TAIYANGNENG [SOLAR ENERGY] in Chinese No 1, 28 Feb 94 pp 6-9

[Article by Wang Changgui [3769 7022 6311]: "Formulate Programs and Adopt Measures To Accelerate the Development of China's New Energy Resource Technology"]

[Text] Starting with the strategic concept of limited mineral energy resources and the inevitably more serious environmental pollution caused by using large amounts of mineral fuels, all countries of the world, especially the economically developed nations, have paid a special attention to developing and utilizing new energy resources and they have placed new energy resource technology in an important position of a supporting technology for the new technological revolution, formulated programs, adopted measures, increased investments, and actively developed them.

In China, new energy resources refer to solar energy, wind energy, biomass energy, geothermal energy, ocean energy, and other renewable energy resources. Over the past 20-plus years, China has had a substantial foundation in utilization of new energy resources and they have played a significant role in construction of our national economy. However, compared with future energy resource development requirements and present world development levels, a substantial lag exists. We should rouse ourselves to catch up and accelerate the development of China's new energy resource technology.

I. The Strategic Importance of Developing and Utilizing New Energy Resources in China

China's strategic objective in utilizing new energy resources in the short term mainly involves solving the power supply problems and energy supply problems of regions that have no power or have power shortages and of special locations, conserving conventional energy resources, and reducing environmental pollution and ecological destruction. Our primary long-term goals should be to optimize China's energy resource structure, continually increase the proportion of new energy resources in our energy resource structure, reduce consumption of mineral energy resources, and make preparations for an energy resource transition in China in the future.

1. Important sociopolitical significance. Statistics through the end of 1992 show that China still had 28 counties, 1,462 townships, and 63,853 villages without electricity and about 30.68 million peasant households and a rural population of 120 million that does not have electricity. Most of these places are in frontier mountain regions, pastoral regions, plateaus, and islands which lack conventional energy resources and are distant from large power grids, and have sparse populations, scattered settlements, and extremely inconvenient communication. However, they have relatively abundant local solar energy, wind energy, biomass energy, and other new energy resources. Thus, the most important way to solve the power supply and energy supply problems of these places is to develop and utilize their locally abundant solar energy, wind energy, biomass energy, and other new energy resources. Moreover, making these places prosperous as quickly as possible has major significance for equilibrium and coordinated development in our national economy, and it has major significance for increasing China's national unity and political stability.

2. Important energy resource economic significance. For the past several years, development of our national economy has resulted in surging growth in demand for energy resources and electric power and it has exacerbated our long-term energy shortages and power shortages. Regarding electric power, statistics show that China's total power generating equipment capacity in 1991 was 151,470MW while our power-using equipment capacity was 367,300MW, for a ratio of 1:2.42 between power generating equipment and power-using equipment (a rational proportion should be two or less). Serious shortages of electric power have frequently resulted in many industrial and mining enterprises, especially those in rural areas, to shut down and stop producing because of power outages, and there have been even fewer guarantees of the electricity for people's lives, which has seriously affected and restricted development of our national economy and improvement in the people's living standards. The planned and gradual development of photovoltaic power generation and wind-powered electricity generation, and the utilization of biomass energy, geothermal energy, marine energy, and other new energy resources can conserve several 10 million tons of standard coal in conventional energy resources as well as play a significant role in alleviating China's shortages of energy resources and electric power and make a substantial contribution to China's modernization and construction.

3. Important environmental and ecological significance. Atmospheric pollution and global warming is an important environmental problem closely related to energy

resources facing the entire globe in the 1990s. Many countries are now adopting measures to solve this problem along with actively increasing energy resource efficiency and energetically improving their energy resource structure. This is the so-called energy resource efficiency revolution and clean energy resource revolution. Currently, in the world's consumption of primary energy resources, about 78 percent is petroleum, natural gas, coal, and other mineral fuels. The burning of mineral energy resources is the primary cause of the continual increase in the atmospheric content of CO_2 and other greenhouse gases and the formation of acid rain. China is third in CO_2 discharges, only below those of the United States and the former Soviet Union. We discharged 23.866 million tons in 1989, 10.9 percent of total world discharges. China is the world's biggest coal producing and consuming country. Statistics show that the amount of CO_2 discharged by coal fuel in China is 85 percent of our total discharges from mineral fuels and 60 percent of China's total greenhouse gases. There are two primary countermeasures for reducing China's CO_2 discharges. One is a major effort to improve energy resource utilization rates and conserve energy resources. The second is gradual improvement of our energy resource structure, major efforts to develop hydropower, solar energy, wind energy, biomass energy, geothermal energy, marine energy, and other renewable energy resources, reducing the consumption of mineral energy resources, and reducing the cutting of forests and the burning of firewood. Data from the United States National Office of Technology Assessment show that common coal-fired power plants discharge 304 grams of sulfur for each kWh of electricity they generate, whereas solar energy thermal power plants that have natural gas reserve generators only discharge 47 grams, geothermal power generation only discharges 2.5 grams, and photovoltaic and wind-powered electricity generation discharges zero. One can see that using several 5-Year Plans to achieve a rather substantial development of new energy resource utilization in China would play an important role in reducing China's discharges of CO_2 and in reducing environmental pollution and maintaining an ecological balance in China.

II. China Has Excellent Natural Resource Conditions for the Development and Utilization of New Energy Resources

China is located in the northern hemisphere with a vast territory and huge population, a suitable climate that extends across tropical, temperate, and frigid zones, and a long continental coastline, which are excellent natural conditions for the development and utilization of new energy resources.

1. Abundant solar energy resources. According to estimates, China's continental surface receives 50×10^{18} kilocalories of solar irradiation each year, which is equivalent to about 170 billion tons of standard coal. All the regions of China as a whole receive 335 to 837×10^4 kilocalories/m^2/year in total solar irradiation, with a mean of 586×10^4 kilocalories/m^2/year. Looking at the distribution of total solar irradiation in China, a vast region in Tibet, Qinghai, Xinjiang, southern Inner Mongolia, Shanxi, northern Shaanxi, Hebei, Shandong, Liaoning, western Jilin, central and southwestern Yunnan, southeastern Guangdong, southeastern Fujian, eastern and western Hainan Island, and southwestern Taiwan have very large total solar irradiation. This is particularly true of the Qinghai Plateau, which average over 4,000 meters above sea level and has a thin and clean atmosphere with good transparency, a low latitude, and a long sunshine time. China's regions with relatively abundant solar energy resources with yearly sunshine times greater than 2,000 hours and total irradiation greater than 586 kilocalories/m^2/year account for more than two-thirds of China's total area, so we have excellent conditions for developing and utilizing solar energy.

2. Relatively abundant wind energy resources. According to estimates by meteorological departments, China's wind energy density is 100 W/m^2 and our total wind energy resources are about 2,530GW, which includes about 253GW that could geographically and economically be developed and utilized in the short term. This is particularly true for the southeast coast and nearby islands, Inner Mongolia and the Gansu corridor, northeast China, northwest China, north China, the Qinghai Plateau, and other regions which have more than 4,000 hours/year in which wind speeds exceed 3 meters/second, and in several regions average wind speeds can reach 6 to 7 meters/second, with an average annual effective wind energy density of more than 200W/m^2 that would have substantial development and utilization value.

3. Enormous biomass energy resources. According to statistics, our total yearly output of crop straw is more than 560 million tons, about one-half of which is used as industrial raw material, feed, and directly returned to fields with the other half being used as a household fuel. China has now created about 4 million hectares of fuel forests. Rational cutting and harvesting of fuel forests and tree varieties that could be used to supply firewood could provide about 110 million tons of firewood a year. Moreover, we also have extremely substantial amounts of animal wastes and other biomass energy resources. However, present utilization modes are very irrational, with straw and firewood equivalent to about 250 million tons of standard coal being burned up each year as cooking fuel in low efficiency and low function combustion modes. Only 2 million tons of straw is used to make biogas, equal to only 0.4 percent of total straw output. Moreover, the utilization of other technologies is practically zero. One can see that there is extremely huge resource potential.

4. Relatively abundant geothermal resources. Through nearly 20 years of surveys, a total of over 4,000 geothermal sites have been discovered to date in China's 30 provinces, municipalities, and autonomous regions. There are almost 90 high-temperature geothermal fields above 150°C, of which 51 are in Tibet, five are in Sichuan, 28 are in western Yunnan, and six are on

Taiwan, so we are one of the countries with the greatest number of high-temperature geothermal fields. There are moderate and low-temperature geothermal resources found throughout China in more than 700 cities and counties, with the provinces along the southeast coast having the most, and the geothermal resources of Tianjin, Fuzhou, Beijing, and other large cities have even greater development and utilization value. According to current survey estimates, China has about 321GW in geothermal resources. Among them, geothermal fields that are mainly basin-type conductive ones have the best development and utilization prospects, with confirmed geothermal resources of 261GW, equal to 81.3 percent of our total resources, and they are mainly contained in the North China Basin and Songliao Basin which are currently producing large amounts of petroleum.

3. China's continental coastline is 18,000 kilometers long, and we have over 6,500 islands of varying sizes with 14,000 kilometers of marine island coastlines where there are abundant marine energy resources. According to a survey of tidal resources that concluded in 1982, we have 186 bays and 33 river mouths with total installed generating capacities greater than 500 kW, and China has a developable tidal energy resource installed generating capacity of 20,580MW which could generate 58 billion kWh of electric power annually, so we are the world's richest country in tidal energy resources. The total power of China's coastal wave energy is about 70GW and its distribution is concentrated in Zhejiang, Fujian, Guangdong, Hainan, Taiwan, and other provinces. According to estimates, China has 50 to 100GW of offshore sea current energy, about one-tenth to one-twentieth the total amount of sea current energy in the world's large oceans.

III. China Has A Substantial Foundation for New Energy Resource Utilization

After efforts through several 5-Year Plans, China now has a substantial foundation for new energy resource utilization.

1. Solar energy: In the area of photothermal utilization, by the end of 1992 we had extended about 140,000 solar stoves, over 2 million square meters of solar energy water heaters, 1.185 million square meters of solar houses, about 147,000 hectares of solar energy plastic sheds, about 5.35 million square meters of solar energy heated poultry and livestock buildings, and over 10,000 square meters of light gathering area for solar energy driers. There have been continual improvements in the technical performance and product quality of solar energy water heaters, and the technical performance of vacuum tube heat collectors has attained international levels. We have completed several key solar energy water heater production plants at a substantial scale. China is the world leader in the number of solar stoves, and we have made relatively large advances in the areas of design theory, materials technology, stove models, and so on. Passive solar energy houses have produced significant benefits in winter season heating in the "three norths" [northwest, north, and northeast China] regions, where they have conserved coal and reduced environmental pollution and enabled the rapid recovery of their increased construction investments. In the area of photovoltaic utilization, we have completed five solar cell production plants on a substantial scale that use imported equipment as a foundation. Their annual production capacity is 3.5MW, including 2.5MW of monocrystalline silicon cells and 1MW of non-crystalline silicon cells. The efficiency of monocrystalline silicon cells has now reached 12 percent, and they have a lifespan of 20 years and a selling price of 40 to 45 yuan/peak W. By 1992, we had applied about 2.5MW of solar cells, with rather good applications in railroad signals, aviation markers, microwave relay stations, satellite ground stations, television transponders, rural carrier wave radio stations, rural household lighting, and other areas. In particular, we have built a 10 kW and a 20 kW independent photovoltaic station and several solar powered satellite television ground receiving stations at Ali in Tibet at more than 4,500 meters above sea level which have solved the power problems for the urgently needed lighting and television reception by the local Tibetan people and raised photovoltaic applications technology in China up to a new level.

2. Wind energy utilization: We have placed 50 to 200 W miniature wind-powered generators into fixed model batch production and they have superior product quality and are reliable and inexpensive. Our annual production capacity is more than 10,000 units, so we have attained an initial industrial scale and even export them in small amounts. We now have a small batch production capability for 1 to 20 kW medium-sized and small wind-powered generators and we are now developing 50 to 200 kW large and medium-sized wind-powered generators. Moreover, 300-t automatic control sail-assisted boats have now been successfully developed on a trial basis and research on wind energy heating is now in progress. According to statistics for the end of 1992, we have now extended and applied about 120,000 miniature and small wind-powered generators with a total installed generating capacity of about 16.8MW. We have now established 11 wind-powered generating experiment farms in Xinjiang, Inner Mongolia, Guangdong, Zhejiang, Fujian, Shandong, and other provinces and autonomous regions that have installed 67 large and medium-sized wind-powered generators with a total installed generating capacity of about 6.2MW. We have extended and applied over 1,600 wind-powered water lifting machines with a total power of about 2.1MW.

3. Biomass energy utilization: By the end of 1992 China had extended household biogas pits to 4,982,100 households. We have established 439 biogas centralized gas supply stations that use organic wastes from distilleries, sugar mills, poultry and livestock farms, and food processing plants as a fermentation raw material that can supply biogas to 73,300 families. These two items can produce about 1.2 billion cubic meters of biogas a year, which has enabled 5.055 million households with a

population of more than 20 million people in China to use a clean and convenient household fuel. Besides being used as a household fuel, biogas can also supply energy for production. China has now established 186 biogas motive power stations with a total power of 3,458.5 kW and 115 biogas power generating stations with a total installed generating capacity of 2.342MW that generate about 3.01 million kWh of electricity annually. China has now established 19,355 city and town household waste water purification biogas pits that, besides providing household energy to 97,200 households, have also cleaned up the environment and reduced the fecal intestinal microorganisms and parasite eggs in the discharged waste water to sanitary standards. The development of comprehensive utilization of biogas has also moved ahead extremely quickly. In 1992 China used biogas to store 219,500 tons of grain, which reduced grain losses by 29,500 tons and saved costs of 220,000 yuan. Bioliquid was used to feed 838,700 hogs, which conserved about 52,900 tons of feed. Bioliquid is being used on a fish-raising water area of 465,000 and it increased fresh fish output by 14.413 million kg and increased income by 43.239 million yuan. Bioliquid was used to soak 13.60 million kg of rice seedlings and increased grain output by 379,000 tons. Now, over 60 percent of China's households use biogas and more than 3 million peasant households have developed the courtyard economy using biogas as a link, increasing peasant incomes by more than 900 million yuan. Research and experiments concerning biomass gasification and liquefaction technology are now actively being carried out.

4. Geothermal energy utilization: In the area of geothermal power generation, we have now completed the world-renowned Yangbajing Geothermal Power Station which currently has an installed generating capacity of 25MW and has generated a total of nearly 400 million kWh of electricity. Its power output now accounts for 40 to 50 percent of the Lhasa Power Grid, so it is playing a decisive role. Two 92°C moderate-temperature geothermal power stations built earlier, a 200 kW one at Dengfang in Fengshun and a 300 kW one at Huitang, have been operating normally and generating electricity for 17 years. China now ranks fifth among the world's 17 geothermal power generation countries in the number of geothermal generators and 12th in installed generating capacity. In the area of direct utilization of moderate and low-temperature geothermal water, we have now extended and applied it in over 20 main projects including bathing, therapy, aquacultural breeding, heating, breeding, seedling raising, flower cultivation, vegetable cropping, incubating poultry, swimming pools, leather processing, food product processing, silk fermentation, laundry and dying, earthquake monitoring, hot mineral springwater beverages, and others. According to statistics, China now has a geothermal heating area of 1.90 million square meters, more than 660 mu of geothermal greenhouses, over 630 hot spring baths, over 180 hot spring sanitoria, and 2,520 mu of total geothermal breeding area. At the end of 1990, the scale of moderate and low-temperature geothermal direct utilization in China was 720 trillion calories/year.

5. Marine energy utilization: We have completed seven tidal power stations and one tidal flood power station with a total installed generating capacity of 11MW. One of them, Jiangxia Tidal Power Station, has an installed generating capacity of 3.2MW and generates about 10 million kWh of electricity a year, ranking third in the world. Small wave energy power generation devices used as power sources for ship signal lights have now entered the application stage and are being produced in small amounts, and they have attained advanced international levels. We have also actively undertaken experimental research on marine temperature differential power generation, seawater concentration differential power generation, sea current power generation, and other things and made significant advances.

IV. Proposals for Accelerating China's Development of New Energy Resource Technology

To accelerate the development of new energy resource technology in China, I will now offer proposals regarding policy issues.

1. Compile a comprehensive, concrete, and feasible new energy resource 10-year development program, include it in the Eighth 5-Year Plan and Ninth 5-Year Plan, and actively organize its implementation. I propose that consideration be given to these points in the program: 1) Agriculture is the foundation of our national economy, so we should make a major effort to solve the power supply problems of rural areas, especially the power supply problems of peasants in regions not supplied with electricity. This is not just an economic problem but a political problem as well. Thus, during the Ninth 5-Year Plan, new energy resource development should be an important task that we give ourselves for basically achieving rural electrification by the year 2000. To eliminate counties that do not have electricity, we must contribute forces to achieve the goal of a peasant household electrification rate of more than 95 percent. 2) In compiling a new energy resource development program, we should have a prominent focus on power generation using new energy resources, and in particular we should consider using wind-powered electricity generation as an important aspect of electric power construction. Strive during the next 10-plus years to complete several 10 large and medium-sized wind-powered generating fields with unit generator powers of 100 to 300 kW and installed generating capacities of 1 to 10MW that operate connected to power grids. In Tibet, Qinghai, Xinjiang, Ningxia, Inner Mongolia, and other regions with abundant solar energy resources, we should also develop a variety of photovoltaic cells as an important way to solve the small load and scattered power use problems of regions distant from power grids. 3) Make major efforts to develop solar houses. China's heating area covers about two-thirds of our total national area. This includes the "three norths" (northwest, north, and northeast China) frigid regions which are the focus of heating. In

these regions, the structural area in cities and towns is now more than 3 billion cubic meters and each year 130 million cubic meters of new city and town residences are being built. We have about 700 to 800 million cubic meters of rural residences. China's structural energy consumption each year is more than 217 million tons of standard coal, equal to more than 22 percent of total energy consumption in China. This includes more than 94 million tons of standard coal that is consumed each year for town heating in the "three norths" region, about 45 percent of our total structural energy consumption. The development of passive solar energy heated houses will play an important role in improving the residential environment, conserving conventional energy resources, and reducing environmental pollution. 4) Use our existing foundation to actively develop geothermal power generation, establish new geothermal power stations, and expand the installed generating capacity of existing geothermal power stations. In regions with abundant moderate and low-temperature geothermal resources, we should actively develop direct geothermal utilization, comprehensive utilization, and cascade utilization. 5) Zhejiang Province has extremely abundant tidal energy resources with several ideal station sites that have large tidal differentials, good utilization conditions, and significant benefits. We should also carry out substantial preparatory work. I propose that we build a large tidal energy power station bigger than 500MW during both the Ninth 5-Year Plan and Tenth 5-Year Plan to provide electric power to coastal regions that have energy and power shortages. 6) Biomass energy gasification and liquefaction and construction of large and medium-sized biogas projects and urban wastewater purification biogas projects is the development direction for biomass utilization and we should provide them with focused support and actively develop them.

2. Make major efforts to strengthen scientific research work for new energy resource technology. New energy resource technology is one of the supporting technologies for the world's new technological revolution, and there are many questions that should be studied and explored, many technical problems that should be attacked, and many new products that await development, so we should make a maior effort to increase investments. Based on China's realities, I propose that we focus on the following prominent scientific research and technical problems: 1) On the basis of importing, digesting, and absorbing, move ahead quickly with research to solve key production technology problems with the 100 kW, 200 kW, 300 kW, and other wind-powered electricity generators that China has been focusing on developing and place them into commercial production as soon as possible. 2) Organize forces to do research to improve the photovoltaic conversion efficiency of monocrystalline silicon solar cells, strive to increase the conversion efficiency of cell assemblies to more than 14 to 15 percent prior to the year 2000, and substantially reduce the cost of monocrystalline silicon cells. 3) Strive to overcome the photodegradation problems of noncrystalline silicon solar cells and try to be able to use them in photovoltaic power station construction prior to the year 2000. 4) Do additional research on corrosion, backflow, environmental pollution, and other prominent problems that exist in geothermal energy utilization, strive to make breakthrough advances as quickly as possible. 5) We should pay sufficient attention to developing the special-purpose materials and equipment required for new energy resource utilization and make the corresponding arrangements. 6) Actively undertake research and experiments on new biomass gasification, liquefaction, and solidification technologies, products, and equipment, and strive to make breakthrough advances prior to the year 2000.

3. Focus on new energy resource industry construction. Although China already has several new energy resource production enterprises, most of them are of a small scale and have weak technical forces. While some do have imported production technology and rather good equipment conditions, for various reasons there have not been enough construction starts. Overall, China's new energy resource industry has still not truly taken shape. In the future we should strengthen construction of key production enterprises for new energy resources, make China's new energy resources achieve an industrial scale, continually improve product quality, increase product varieties and specifications, reduce costs, provide good after-sales services, create more name-brand products that users trust, and open up a broad market.

4. The state should provide substantial support for new energy resource utilization and implement preferential policies. Because new energy resource technology is high and new technology is now being studied, explored, and developed with an eye to replacing energy resources in the future, much new energy resource construction involves poverty assistance activities to make the people of poor and backward regions prosperous while many new energy resource utilization projects involve public welfare activities to reduce environmental pollution and protect the ecological equilibrium. Thus, China like other countries in the world should actively encourage and support new energy resource R&D, extension, and applications by implementing tax exemptions and reductions, subsidies, no-interest or low-interest loans, and other preferential policies.

5. Actively undertake international cooperation, fight for assistance from foreign countries through a variety of channels and in a variety of forms. China already has several projects assisted by foreign countries in wind energy, solar energy, biomass energy, and other areas and the results have been excellent. However, compared to Brazil, India, the Philippines, and other countries, the assistance projects and capital that we, as a large developing country with a population of 1.2 billion, have fought to obtain are extremely few. We should liberate our ideology, take action, and fight for more assistance for new energy resource projects from foreign countries through a variety of channels and in a variety of forms to spur the development of new energy resource utilization

in China. The state and local areas should provide the matching capital support for projects receiving international assistance.

Role of New Energy Resources, Conservation in Nation's Energy Development Strategy

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[Article by Huang Yicheng [7806 3015 6134] of the National People's Congress Finance and Economics Commission: "Ideas on China's Energy Resource Development Strategy"]

[Text] Energy resources are an indispensable material foundation for mankind's social progress and economic development and for people's daily life. Based on the "three steps" idea of comrade [Deng] Xiaoping, if we want to build China up to "near the economic levels of developed countries," besides other conditions, we must have guarantees of energy resources. Thus, on the basis of China's concrete conditions we must consider China's energy resource development strategy.

China's characteristics are 1) a large population, and 2) low energy resource consumption levels. At present, each person in the developed countries consumes an average of more than 5 tons of standard coal a year (the United States has already surpassed 10 tons), whereas China's total energy resource consumption in 1992 was about 1.1 billion tons of standard coal, which when divided by our population of 1.1 billion gives a per capita figure of about 1 ton of standard coal. Coal accounts for about three-fourths of the energy resources we consume.

If an economy is to develop and people's lives are to be improved, then per capita energy resource consumption must certainly increase. However, this increase must be restricted by various factors such as resource and environmental restrictions, and so on. In another 50 to 60 years, when China's economy approaches the levels of the developed countries, our population will have grown to about 1.5 billion. At that time, even if we do not attain a per capita energy resource consumption of 5 tons of standard coal but will only reach 3 tons, China's total energy resource consumption would be 4.5 billion tons of standard coal. In the present situation in which China only consumes 1.1 billion tons of standard coal a year, China's atmospheric discharges of sulfur oxides, nitrogen oxides, carbon dioxide, and other pollutants have already approached the amounts discharged in the United States, the world leader. It is very hard to envisage that in several decades China will be producing, transporting, and burning several billion tons of coal because of the serious impact this would have on China's economy and the atmosphere and environment.

Today, we all live on the earth which we all depend on for our existence, energy resource development strategies and policies have now crossed over national boundaries, and they can affect not just the existence and development of the people of one's own country but have a worldwide impact as well. Thus, when we are studying China's energy resource development strategy, we must look at balancing demand, resources, finances, and other conditions, and we must strive to maintain equilibrium among energy resource production and consumption and the ecology and environment.

Based on this principle, I feel that besides the need to accelerate the development of conventional energy resources in the short term, China's energy resource development strategy should focus on two areas. First, we must adopt important measures to increase energy resource utilization efficiency, use our present 1.1 billion tons of standard coal properly, and use strategy to focus on energy conservation. Second, we must develop nonpolluting renewable energy resources, especially hydropower, bioenergy, wind energy, and solar energy.

I. Conserve Energy Resources, Increase Energy Resource Utilization Efficiency

The efficiency of energy resource utilization in China is rather low at present with an overall efficiency of only about 30 percent, our energy consumption per unit GNP is 6 to 10 times higher than in the advanced countries, and our energy consumption to produce a unit of product is 50 to 100 percent higher than in foreign countries. There is considerable potential for using our present energy resources well. Thus, conservation of energy resources is an important national policy of our country and should be adhered to for a long time. We must establish laws and regulations regarding energy resource utilization. In production and consumption, we must make conserving energy and improving energy resource utilization efficiency an important standard for checking.

1. We must make macro readjustments in the industrial structure and product mix and energetically develop those industries and products with low energy consumption and high product value. Several large energy-producing provinces (such as Shanxi and Heilongjiang) in China's interior have energy consumption per unit of product value more than five times higher than economically developed provinces along the coast (such as Jiangsu and Zhejiang), and two of the main reasons are the significant differences in their industrial structures and product mixes.

2. We must require that newly-built enterprises and restaurants, hospitals, schools, residences, and so on conform to new energy resource consumption standards, have specialized personnel to conduct energy conservation inspections of these designs, and not approve the construction of those that do not meet the standards. We certainly cannot build those that do not conform to energy conservation standards at the time they are being built and that will require technical upgrading for energy conservation after they are placed into use. Rational energy consumption standards should be formulated for all new energy-consuming products that go into production such as water pumps, blowers, electric motors,

refrigerators, televisions, washing machines, and so on, and they should be strictly examined and we should not permit the production of those that fail to meet requirements. Those products that are already in production should attain energy consumption standards within a limited period of time.

3. We must focus on energy conservation and reducing consumption in all industries.

In the electric power industry, for example, the average amount of coal consumed to supply electricity per kWh of power from thermal power plants in 1992 in China was 420 grams of standard coal. This was 10 grams lower than in 1990, but it is just 320 grams in advanced countries like Japan, Italy, and others, and in the former Soviet Union, because they developed a large number of heat and power cogeneration plants, the amount of coal consumed to supply electricity is even lower, just 310 grams per kWh. The former Ministry of Energy Resources pointed out that the amount of coal consumed to supply electricity in China's thermal power plants should be reduced from 430 grams in 1990 to 360 grams in 2000, a reduction of 70 grams. At that time, thermal power in China will generate 1 trillion kWh of electricity, so this could conserve about 140 million tons of coal. The 360 gram index is not so high as to be unattainable. Shitongkou No. 2 Power Plant, imported and built by the Huaneng Company, has two 600MW generators that only consume 300 grams/kWh to supply electricity. If all of China attained this level by the 2020s and projecting China's thermal power output then at 3 trillion kWh, this could conserve 400 million tons of coal.

The state should formulate a series of policies to spur energy conservation in the electric power industry. The most important among them is raising depreciation rates in the electric power industry to ensure that a power plant's depreciation capital over 15 years is sufficient to enable it to replace its equipment. In addition, we must strengthen power plant management and demand energy conservation results in management. Enterprises that manufacture power generation equipment should continually improve design and manufacturing levels and reduce coal consumption in the power generation equipment they produce to less than 300 grams within 10 to 20 years.

In another example, developing centralized heat supplies and heat and power cogeneration is an effective way to raise energy resource utilization efficiency and conserve energy resources. China has over 500,000 industrial boilers and heating boilers that burn up over 400 million tons of coal a year, and each year we must add small boilers with over 10,000 tons of steam output. Because the capacity of these boilers is too small, it is very difficult to achieve automatic coal loading for burning and it is very hard to attain the design thermal efficiency levels of large and medium-sized boilers (over 90 percent). The result is high energy consumption and low thermal efficiency which, added to the great difficulty in carrying out dust removal in small boilers, also results in substantial pollution. Even more regrettable is that because they have users of heat, they already had good conditions for creating energy conservation and reducing coal consumption in thermal power plants, but they have not really been utilized. Currently, the thermal efficiency in thermal power plants is only about 35 percent, and the main reason is the presence of unavoidable "cold-end losses" in which nearly 60 percent of the heat energy is discharged into the atmosphere. If they had users of this heat, they could recover and utilize these losses to supply heat, which would greatly increase the overall thermal efficiency. This was what the former Soviet Union did.

Implementing centralized heat supplies can turn scattered small boilers into large and medium-sized boilers, which can raise automatic operating levels, improve boiler efficiency, and raise dust removal levels. Having larger boilers means higher steam parameters, and the steam can first be used to generate electricity and then the steam that generated the electricity can be supplied to heat users, which means heat and power cogeneration plants. Calculated and actual results show that adopting this type of upgrading measure can conserve one-half of the energy resources. The State Planning Commission's Energy Conservation Investment Company has conducted experiments at several sites nationwide with substantial benefits. Dandongbei Chemical Fiber Plant, for example, replaced over 50 scattered small boilers with three 70-t powdered coal boilers and replaced nearly 30 small smokestacks with a large smokestack fitted with electrical dust removal, and it installed two 12MW back pressure-type steam turbine generators. This small cogeneration plant burns the coal from its former 50-plus scattered small boilers to supply heat and generate an additional 24MW of electricity, and it can conserve about 50,000 tons of coal a year while at the same time solving the region's long-term atmospheric pollution problems.

Experts in China and foreign countries feel that heat and power cogeneration is an effective energy conservation measure. The United States originally had not extended cogeneration, but to raise energy resource utilization efficiency during the Carter administration it formulated encouragement policies. Substantial advances in heat and power cogeneration in the United States during the past 10 years have raised the overall efficiency of energy resource utilization. To encourage and support the large number of scattered heat supply small boilers China now has in upgrading to centralized heat supply and cogeneration plants to produce both heat and power, the State should formulate several policies such as having the State provide more than one-half of the loans for independently built small cogeneration plants in the investment per kW of installed generating capacity, allowing the surplus power that is generated to be sold to power grids at the same price as thermal power, allowing small cogeneration plants to not participate in grid peak regulation, and so on.

In summary, there is great potential for using our existing energy resources well and raising energy

resource utilization efficiency to conserve energy resources. Above, I discussed examples in two areas, but there are many other large energy consumers such as the metallurgical industry, chemical industry, construction materials industry, construction industry, and others where there is great potential that could be exploited in the area of raising energy resource utilization efficiency. For example, the electricity used for lighting in China currently uses large numbers of incandescent lights, whereas new types of energy-saving lights can conserve more than 80 percent of the electricity compared to incandescent lights. If we used new types of electrical light sources, the amount of electricity that China would conserve in one year would be equivalent to adding 20,000MW in installed generating capacity! In another example, the world's developed and relatively developed countries all use hollow-core bricks in their structures, which can conserve electricity by 30 to 40 percent, whereas China still uses solid-core bricks. For this type of broad-ranging and mature energy saving technology, the State should certainly make the decision to use legislation to extend them and engage in administrative intervention when necessary.

Conserving energy is a matter for all of us. We must establish and raise all people's energy conservation consciousness. Energy conservation should not result in inconvenience in people's lives but should instead use improvement of energy resource utilization efficiency and the establishment of energy-saving industries, an energy-saving economy, and an energy-saving society to consume the least possible amount of energy resources to produce the greatest possible amount of material wealth to make people's lives even more convenient and attractive.

Conserving energy requires substantial capital inputs. In the overall calculation, however, the investment to conserve 1-t of standard coal is more economical than new construction. The state should set aside a portion of investments from its investments in energy resource capital construction for use in energy conservation. It should also focus on energy conservation in its technical upgrading investments.

II. We Must Energetically Develop Non-Polluting and Renewable New Energy Resources

1. Make a major effort to develop hydropower

China has over 600,000MW of theoretical hydropower resource reserves with 378,000MW that could be developed and used. Currently, we have developed only 40,680MW and even though we plan to place 4,000MW into operation during 1993 the extent of development and utilization is still far from adequate. Thus, we must accelerate the pace of hydropower construction, adapt to local conditions, and move forward with large, medium-sized, and small hydropower stations. First of all, there should be attraction in policies to give everyone the initiative to invest in developing hydropower. We must speed up preparatory work, accelerate the pace of construction, and shorten construction schedules. In the management system, we must establish the corresponding development companies based on river basins (such as the Qing Jiang Development Company) and provide them with policy support such as permitting the recovery and reloaning of state investments, etc., to enable them to achieve rolling development.

2. Extend bioenergy resources

China formerly led the world in developing biogas but because of the effects of the small-scale agricultural economy, with each household building its own small pit, the gas production efficiency is low and the intensity of labor is great, so they have developed slowly. Holland's recent experience in building large biogas pits on cattle farms and using heating and mixing technology can increase gas output by a factor of three and produce gas year-round, with the biogas being used to generate electricity. We should adopt advanced technology, increase the scale and mechanization levels of biogas construction, and achieve industrialized production.

China produces over 600 million tons of crop straw each year. The current direction is ammoniation of straw, utilizing the vitamins and proteins in the straw to raise cattle, sheep, and hogs, and using livestock wastes as a biogas raw material to produce biogas. Biogas production only utilizes the carbon and hydrogen contained in the straw, while the dregs retain the nitrogen, phosphorus, potassium, and other elements in the straw. This could be an important strategic measure in development of the rural economy, and I propose that the State might as well work on "straw engineering." There is also abundant grass, stalks, leaves, organic wastes, and so on that can be used as raw material for producing biogas.

Developing new types of biogas pits is an important way to provide energy resources to rural areas and they can be developed by adapting to local conditions in cities and townships. This is a good arrangement for dealing with excrement and garbage in an energy-saving society. Moreover, enterprises that generate organic residues and waste liquids can establish new types of high efficiency biogas pits to obtain energy resources and improve the environment.

Another way to utilize bioenergy is using agricultural products to produce alcohol, and some countries are now conducting experiments. There are also prospects for using wood chips, bagasse, fruits, tubers, and so on to produce alcohol for use as an automobile fuel.

3. Make major efforts to develop wind energy

Wind energy is one of China's big advantages. The work done over many years by meteorological stations indicate that China has over 400,000MW of usable wind energy, distributed mostly along the coast and in the wind energy belt running from Xinjiang through Inner Mongolia to northeast China.

Wind-powered electricity generation is simple and does not pollute the environment. It is receiving attention in a growing number of countries like the United States, England, Denmark, Holland, India, and other countries where it has developed very rapidly in recent years. China has worked on small (200 to 300 W) wind-powered generators for several years and now has a foundation. We have now extended more than 100,000 units which have partially solved the electricity supply problems for lighting and television of grasslands pastoralists with very good results. However, China's development and utilization of wind energy as a proportion of our energy resource consumption is miniscule, and we should develop it quickly to gradually turn it into a force in our energy resources.

Currently, the main problem in energetically extending wind-powered electricity generation is that the technology for large and medium-sized wind-powered generators in China is not mature and our equipment must rely on imports, so manufacturing costs are high. We must import internationally mature technology such as large wind-powered generators with unit capacities of 200 to 400 kW and organize large batch domestic production. It is entirely possible to reduce the manufacturing costs per unit kW to the present level for hydropower construction. All countries of the world have adopted preferential policies for developing wind energy such as tax exemptions, allowing the electricity that is generated to be supplied to grids, providing electricity prices that permit repayment of the principal and interest, and so on, and China should do this too.

4. Develop and utilize solar energy

Solar energy is a very clean energy resource. It can be said that China is also very rich in solar energy. China's average annual sunshine time is more than 2,600 hours, and some regions (such as northwest China and Tibet) have sunshine times of more than 3,000 hours. It we use it to generate electricity, we could generate it for as many hours as hydropower does on the average in China. There is still no scientific figure for the usable amount of solar energy that China has, but it certainly is greater than hydropower and wind energy.

During the past several years China has made many advances in the area of utilizing solar energy, mainly in the areas of building greenhouses to produce vegetables and using solar energy to produce hot water, but we only have a few trial projects to use solar energy to generate electricity.

Foreign countries have done a great deal of research and experimental work in recent years on utilizing solar energy to generate electricity and they have made significant advances and substantially reduced the costs of power generation. They have progressed from monocrystalline to polycrystalline silicon and developed from polycrystalline silicon to non-crystalline silicon and recently have also developed to crystal plated film, and the photovoltaic conversion efficiency has risen from a few percent to over 10 percent. Now the total investment cost has dropped to $1,000-plus per kW. As the technology advances, developing solar-powered electricity generation in large amounts will become a possibility. In this field, we should organize scientific research forces, closely track advanced steps in the world, and prepare to make solar energy an important force in China's energy resources.

We should also do some research and experimental work in the areas of using solar energy for structural heating and supplying residential hot water. We should further improve utilization efficiency and solve the technical problems of using solar energy during the winter.

5. Develop hydrogen energy and other renewable energy resources

There are huge reserves of hydrogen. All countries in the world are now doing research on ways to economically produce hydrogen. Chemical methods can be used to produce hydrogen, and solar energy and surplus hydropower can be used to produce hydrogen. Breakthroughs in this area could provide us with clean and huge reserves of hydrogen. China should also undertake research in this area.

Geothermal resources are relatively abundant in many locations in China, and ways to further develop and utilize them in a planned manner should receive our attention.

There is also tidal energy, wave energy, and so on that can be developed and utilized in adaptation to local conditions.

6. Accelerate the development of nuclear power

It should be said that nuclear power is also a clean energy resource. The world has now completed 424 nuclear power reactors and the safety problems and technology that worry people have now been guaranteed. Moreover, new types of nuclear power plants are now being developed that can be made even safer. In coastal regions, if we fail to develop nuclear power in the long term I fear that we will be unable to solve their power supply problems in economic development.

Because purchasing nuclear power equipment from foreign countries is expensive (the investment in the two 900MW generators at Daya Bay is more than $4.1 billion), we will be able to develop it on a larger scale when we can do our own manufacturing. Nuclear power has made progress in China in recent years, but for various reasons the progress is too slow and Korea, which does not have the machinery industry that China does, has caught up with us.

In summary, a correct energy resource development strategy will affect China's economic development and affect the lives of every one of our citizens. I hope that experts in this area can all participate in research and discussion on China's energy resource development strategy, draw on collective wisdom and absorb all useful ideas to form correct policies, and include them in the state's economic and social development strategy and programs so that all industries, all departments, and all regions can implement them.

Yangbajain Geothermal Deep Well Project Passes Appraisal

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[Text] On 15 March, the "Xizang Yangbajain Geothermal Deep Well" project passed appraisal by the China Energy Expert Committee in Qiaoxia County.

Xizang is rich in geothermal resources and data support State energy development criteria for the creation of 10,000-kilowatt-class geothermal electric power plants. The Yangbajain deep well project would make use of a single-unit 12,000-kilowatt geothermal power plant that draws on deep-well high-temperature, high-energy underground heat sources. The project could be completed and in operation in 1995.

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